South Carolina
Research Centers of Economic Excellence
Review Panel Report

June 20, 2005

In May 2005 a Review Panel of eight consultants convened in South Carolina to review and assess the merits of Endowed Professorship proposals submitted to the Research Centers of Economic Excellence Review Board during the 2004-05 funding cycle.

This document presents the findings and recommendations of the Review Panel and is organized as follows: Part One provides an overview of the Endowed Chairs program; Part Two provides general findings and recommendations from the Review Panel; Part Three describes the Panel's recommendations for funding based on their review of the 2004-05 proposals; Part Four provides Panel recommendations for the development of infrastructure supportive of the Endowed Chairs program; and Part Five offers a summary conclusion from the Panel.

Part One: Program Overview

Program Description and History. During the 2002 legislative session, the South Carolina General Assembly passed the *South Carolina Research Centers of Economic Excellence Act*. With an annual allocation of up to $30 million in lottery funds, to be matched on a dollar-for-dollar basis with non-state funds, this competitive grants program awards to South Carolina's three research universities funds to establish Endowed Professorships in areas that will enhance economic opportunities for the state's citizens. The program is funded by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200 million by 2010.

Awards are made through a competitive application process which encourages collaboration among the three research institutions and with other higher education institutions in the state. Funding decisions are made by a nine-member Research Centers of Excellence Review Board, three members of which are appointed by the Governor, the President Pro Tem of the Senate, and the Speaker of the House respectively.

Current Program Status. Over the last two years the Review Board has approved funding for 17 research proposals from USC, MUSC, and Clemson University and their partner-institutions, totaling $72.5 million in state lottery funds. To date over $19.5 million in lottery funds has been drawn down and distributed to the institutions, and the institutions report $49 million in matching fund pledges, of which $30 million has been received.

The 17 Board-approved Research Centers represent a diverse palate of research fields. Projects from Clemson University include Automotive Research and Vehicle Electronic Systems University (associated with the International Center for Automotive Research, or ICAR), and Historical Restoration. Projects at the University of South Carolina – Columbia include Nanotechnology, Hydrogen Storage and Hydrogen Fuel Cell Sensors, and Travel and Tourism Technology. Projects at MUSC include Proteomics (protein research), Marine Genomics (genetic research), Brain Imaging, Regenerative Medicine, Neuroscience, and Cancer research. Partner institutions for several Centers include the College of Charleston and Coastal Carolina University. Several Centers also represent collaborative efforts among the state's three research universities.

The program is currently in its third year. The 2004-05 funding cycle included 15 individual and collaborative proposals:

	Institution	Proposal Title	Amount	Endowed Chairs
1	Clemson	Supply Chain, Optimization & Logistics	$2,000,000	1
2	Clemson	Urban Ecology & Restoration	$2,000,000	1
3	Clemson	Electron Imaging	$5,000,000	1
4	Clemson/MUSC/USC	Molecular Nutrition	$2,500,000	1
5	Clemson/USC/Coastal	Tourism Competitiveness	$2,000,000	1
6	USC	Carolina Laser Lighting	$5,000,000	1
7	USC	Tech. Commercialization & Innovation	$2,500,000	1
8	USC/MUSC	Biodefense & Biosecurity	$5,000,000	2
9	USC/MUSC	Translational Cancer	$5,000,000	3
10	USC/MUSC	Bioinformatics/Memory Therapeutics	$5,000,000	3
11	USC	Fuel Cells/Hydrogen Economy	$5,000,000	1
12	MUSC	Gastrointestinal Cancer Diagnostics	$5,000,000	1
13	MUSC/USC	Vision Science	$4,500,000	3
14	MUSC/USC	Patient Simulation Center	$5,000,000	3
15	MUSC/USC	Stroke	$5,000,000	4
		Total Amount of Requests	$60,500,000	

Evaluating the Proposals. The process of assessing the quality and viability of each proposal proceeded in two phases. The first phase involved submitting the proposals via e-mail to external reviewers to determine the technical merit of each research project. The goal of this process was to obtain a minimum of four technical reviews: two from reviewers recommended by the institution submitting the proposal, and two from acknowledged experts in the field who have not been recommended by the submitting institution. Reviewers were asked to assign points to the proposal in each of four categories: Scientific and Technical Merit (up to 40 points); Approach, Process, and Execution (up to 25

points); Innovation (up to 25 points); and Infrastructure, Support, and Collaboration (up to 10 points). The maximum point total is 100.

The second phase of review involved assembling a team of consultants ("Review Panel") to visit the campuses, attend formal presentations by the Principal Investigators submitting the proposals, and meet with institutional leaders. Prior to their arrival in South Carolina, the Review Panel received and reviewed the proposals in their entirety, as well as the phase one technical reviews. Although the Review Panel carefully weighed the technical merits of each proposal, the primary focus of their assessment was upon the degree to which each proposal was consonant with institutional mission and the potential economic contribution of each project to the state of South Carolina.

Further, each proposal was assigned a lead reviewer and a secondary reviewer. The role of the lead reviewer was threefold: 1) to serve as the effective chair of the Panel for that proposal, including taking the lead in formulating questions; 2) leading the Panel's internal discussion and ranking of the proposal during deliberations; and 3) drafting the narrative section required for the final report. The second reviewer provided reinforcement and support for the lead reviewer assigned to each proposal. Each Panel member served as the lead reviewer for two proposals and as secondary reviewer for two proposals.

At the conclusion of each day's campus visits the Review Panel convened to discuss the proposals and begin drafting a preliminary report. During subsequent weeks the Panel, under the guidance and direction of Panel Chair Walters, communicated via telephone and e-mail to arrive at final conclusions and funding recommendations. The 2004-05 Review Panel included three returning consultants and five new Panel members:

Name	Title	Institution
E. Garrison Walters, Ph.D. (Chair, returning)	Vice Chancellor for Academic Affairs and Economic Advancement	Ohio Board of Regents
Susanne Huttner, Ph.D. (returning)	Assoc. Vice Provost for Research	University of California
David Millhorn, Ph.D. (returning)	Director, Genome Institute	University of Cincinnati
Tony Waldrop, Ph.D.	Vice Chancellor for Research	UNC – Chapel Hill
David Campbell, Ph.D.	Provost; Dean of Engineering	Boston University
Steve Tharratt, M.D.	Professor, Department of Pulmonary/Critical Care Medicine	UC Davis Medical Center
James Roberts, Ph.D.	Vice Provost for Research	University of Kansas
Jack Burns, Ph.D.	Vice President for Academic Affairs & Research	University of Colorado

Part Two: General Findings and Recommendations

The Research Centers of Economic Excellence 2005 Site Review Panel conducted a visit to Charleston (MUSC), Clemson (Clemson), and Columbia (USC) on May 1-4, 2005. Thanks to the excellent work of the staff of the South Carolina Commission on Higher Education, the participating universities, and the many collaborating organizations, the visit was very well-organized and highly informative. Taken together with the extensive documentation provided in advance, the Review Panel believes that it had access to sufficient information to make recommendations for funding. Those recommendations are provided in detail in Part Two of this report.

The extensive documentation on the Research Centers program, together with the opportunity to interact with university personnel and representatives of affiliated organizations, provided the Review Panel with an opportunity to comment on the overall purpose, structure, and foundations of the program.

Strong Universities. The 2005 Review Panel concurs with the Review Panels from prior years' visits on the quality of South Carolina's research institutions. The state has reason to be proud of their accomplishments, and the Review Panel wishes to emphasize some of the achievements that are especially important to the Research Centers program.

Leadership. Implementing complex plans requires sophisticated guidance, and the Review Panel believes that South Carolina's research universities have excellent leadership overall, and in the areas of research and economic development.

Strategic Planning. Virtually every organization today employs some form of strategic planning, and the attendant processes have produced many fine words. Unfortunately, implementation in the real world is often lacking.

But strategic planning is an area where South Carolina stands out. The three universities have clearly gone beyond rhetoric and are implementing specific plans and making real, tangible progress. The universities began their planning at different times and as a result are not all at the same level of implementation, but the Review Panel believes that all plans have the potential to be highly successful.

A central element of the strategic planning at the three South Carolina universities is focus—putting a disproportionate share of resources on a few key areas where the university has a chance to excel. In today's complex research environment, where scale is an increasingly important factor in achieving the critical mass of talent, facilities, and equipment, focus of this kind is essential for all but a handful of the largest and most comprehensive institutions.

A key point about the universities' decisions on focus is that strengthening the economic development of South Carolina (while also improving the quality of life for its citizens) has been the driving criterion.

Institutional focus does have a downside. Isolated programs can have difficulty in securing the resources needed to be competitive. Shifting the necessary funds at a small or even a medium-sized institution can create a burden for other programs and threaten its ability to offer the needed array of undergraduate degrees. A better solution is multi-institutional collaboration, and, as discussed in the next section, the Review Panel believes that this is another significant South Carolina strength that is anchored in the Research Centers of Economic Excellence program

Collaboration. The Review Panel was very impressed with the level of collaboration among South Carolina's three research universities. As with the institutional strategic planning, there is a high level of substantive activity that transcends the rhetoric typically encountered in most parts of the country (team members who have been present for all three rounds note that there has been considerable progress in this area since 2003).

Particularly praiseworthy are the decisions to create a joint school of pharmacy between USC and MUSC and the creation of the Health Sciences South Carolina concept.[1] These are major undertakings that will require extensive administrative energy and—not to be overlooked—patience. Major initiatives of this kind, taken together with the array of activities in other areas of life sciences, travel/tourism, and more, suggest that the initials "SC" could stand for "Spirit of Collaboration" as well as South Carolina.

Despite the strong praise for existing collaborative activities, the Review Panel is concerned that lack of broadband networking infrastructure may prove to be a significant barrier to progress unless a major new effort is put into place. Further explanation of this topic is provided in Part Three: Recommendations for Infrastructure.

The Program. The Review Panel applauds the state of South Carolina for its vision in developing and implementing the Research Centers of Economic Excellence program. As the United States moves into what the writer Thomas Friedman calls a "flat world," where knowledge is the principal currency, a state cannot make a better investment than in its research institutions.

The use of endowed chairs as the program's centerpiece is a wise one. Startup might be a bit faster if cash flowed directly, but the value of the match, together with the sustained nature of an endowment, more than makes up for this.

South Carolina should expect short term (1-3 years after activities begin) benefits from the program. While mature commercial spin-offs are unlikely in this time frame, these investments in science and technology should enable the

[1] A brief description is included in the Appendix.

recipients to compete for research funds sponsored by the government, foundations, or industry. According to the Association of American Universities, every $1 million in total research expenditures supports 36.5 high-value, high-wage R&D jobs.[2]

While the short term economic potential of these investments is enormous, it should be emphasized that nothing here is guaranteed. Federal funds for research have stopped growing—both the NIH and NSF budgets have lost their growth momentum—at the same time that the number of institutions making a major effort to compete increases. If South Carolina expects that part of its ROI for the Research Centers of Economic Excellence program will be from federal research, it needs to be very careful to direct its funds only to those programs that have clearly demonstrated existing competitive strengths as well as the clear prospect of continuing access to the platform of people, facilities, and equipment necessary to stay the course in an ever more aggressive environment.

For the medium term (3-7 years), many of the proposals envision the creation of start-up companies. This will certainly happen to some extent, though the Review Panel emphasizes that this is an uncertain measure of success, dependent on an array of variables. In many fields, a more likely outcome in the medium-term is the attraction and expansion of existing companies. Outstanding research centers are a powerful magnet for technology companies seeking additional or alternative sites.

In the long term, the Research Centers of Economic Excellence Program, if sustained and complemented with other investments in education, should strengthen the perception of South Carolina as a place with an active role in the knowledge economy. This, in turn, will attract educated people to the state—including in areas not directly connected with the Research Centers—and also encourage more, and especially more of the best, graduates to stay. This investment in educated people is similar to what North Carolina began to make over forty years ago. The other Carolina's success will not be easy to emulate. Progress will not be linear or fast. But consider the alternative. Not investing in educated people in today's knowledge economy would be like state leaders saying, a hundred and fifty years ago, that they did not think railroads should be a priority or, fifty years ago, deciding that using state funds for Interstate highways was a waste of money.

In summary, the Research Centers of Economic Excellence is an exceptionally well-conceived program. The investments will have significant short and medium term benefits, and will help create a "buzz" about the state, that sense of being on the leading edge that makes bright people want to stay and others want to come.

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[2] Derived from data at: http://www.aau.edu/resuniv/FY97Employ.html .

Part Three: Recommendations for Funding

The Review Panel has provided three general rankings for the proposals it reviewed:

Category 1, for immediate funding.

The Review Panel believes that programs listed here are already of high quality, have clearly defined goals and objectives, have most of the key resources for success in place and, if awarded one or more endowed chairs, should find the needed match reasonably quickly and move quickly to greater success. Proposals in this category are *not* rank ordered.

Category 2, meritorious, but with one or more significant failings that could be remedied. Resubmission is encouraged, but should require a new proposal and some further external review by experts in the field.

These proposals are similar to those in Category 1 in many ways but require at least one significant change prior to being funded. The Review Panel has tried to state clearly the change or changes that are needed, but does not believe that funding should be provided without further external review to determine whether the problems have been resolved. Proposals in this category *are* rank ordered. *(Panel findings on Category 2 not publicly released).*

Category 3, having serious or structural flaws. Resubmission is not encouraged without important re-conceptualization and clarification that would be equivalent to a new proposal.

The Review Panel believes that these proposals require substantial rethinking and would not recommend funding even if revised. Instead, new proposals could be advanced in the next competition. Proposals in this category are *not* rank ordered. *(Panel findings on Category 3 not publicly released).*

Recommendations on the Individual Proposals

Category 1 - Recommended for Immediate Funding- (Total amount $19,500,000)

The Review Panel did not assign a ranking to proposals within this category.

MUSC/USC VISION RESEARCH $4,500,000

- DESCRIPTION

This proposal was submitted by MUSC and USC for three endowed professors in the areas of gene and pharmaceutical treatment for retinal degenerative disease and bioengineering and materials science for surgical innovation and drug delivery.

- STRENGTHS

The proposed endowed professorships build upon the existing scientific and clinical strengths at MUSC and USC in vision research and treatment (for example NIH funding ranks tenth in the nation). The recruitment of three established scientists will elevate the proposed Vision Research Center to high national prominence. The proposal has strong institutional support and is well along in obtaining private-sector pledges for matching funds. The opportunity for commercial development of products is promising. The recruitment strategy for the endowed professorships is well conceived and the chance of recruiting prominent scientists into these positions is good. The leadership for the proposed center is strong and should be a positive factor for future successes.

- WEAKNESSES

The availability of adequate laboratory space may hinder the recruitment efforts. The ability to develop novel therapeutic approaches or products is difficult and not well described. The research plan is somewhat broad and might require a more focused approach on one or two vision related diseases. A plan to recruit additional junior faculty to provide a critical mass of vision researchers was not well described.

- RECOMMENDATION

The Review Panel recommends full funding ($4,500,000) of this proposal.

MUSC GASTROINTESTINAL CANCER $5,000,000

- DESCRIPTION

This proposal seeks to establish an Endowed Chair in Gastrointestinal Malignancy at MUSC.

- STRENGTHS

Strengths of this proposal include the clinical commitment to gastrointestinal malignancies, articulated integration with translational scientists including molecular diagnostic and proteomics, as well as a well constructed development and evaluation plan for the center.

Key to the success of this proposal will be the development of the medical research network anchored by the Hollings Cancer Center involving the major regional medical facilities in South Carolina. The success of this partnership will be unequivocally required for an eventual comprehensive cancer designation (P-30) by the National Cancer Center (NCI). The Review Panel believes that the factors necessary for success are in place.

- WEAKNESSES

A minor, non-fatal, criticism of this proposal is the overly optimistic description of the potential for commercialization of technology developed by the center. The economic development potential of this proposal for South Carolina lies in the Regional Cancer Center network development and the ability to enhance the eventual proposal to the NCI for a Comprehensive National Cancer Center Designation.

- RECOMMENDATION

The external review committee recommends full funding ($5,000,000) of this proposal.

USC FUEL CELLS $3,000,000

- DESCRIPTION

The written proposal suggested a single Endowed Chair in "Renewable Fuels for the Fuel Cell Economy" with a specific focus on the development of new catalysts to produce hydrogen (and other alternative fuels) from renewable sources. At the oral presentation, the scope was broadened to include two Endowed Chairs (without increasing the requested support), one in catalysis and one in genetic/biological research to develop new techniques for extraction from "biomass."

- STRENGTHS

USC is a national leader in the area of fuel cells, with the only NSF-sponsored Industry/University Cooperative Research Center (I/UCRC) in the area of fuel cells. They current have 15 dues paying members of the I/UCRC and have good ties to Savannah River National Laboratory (SRNL), which has a strong program in hydrogen storage materials, a key aspect of fuel cells.

One half of the USC chemical engineering PhD students are in fuel cell research, and USC has strength in hydrogen storage. In addition, the South Carolina legislature has added funding for hydrogen research. USC has made a major commitment to research space and positions in support of this effort, and has discussed the position with a candidate. While there is not enough money in the proposal to land this person and the appropriate

team, the office of the Vice President for Research has agreed to provide the additional support to recruit the individual. The University also has targets for the other positions. USC appears to be doing an excellent job of going after the people they need.

The presentation featured strong support from South Carolina industry, and half of the required match is already in hand.

The focus on renewable sources, in particular the extraction from biomass, is appealing and is especially attractive in that rural South Carolina farmers would be producing the fuel. In this way, the plan marries the research strengths of the universities and industry with the traditional agricultural economy.

- WEAKNESSES

The committee found the differences between the written proposal, as submitted and reviewed by the mail reviewers, and the oral presentation at the site visit to be both confusing and indicative of an inappropriate uncertainty in the project. In particular, while the case for an expert to develop new catalysts to convert biomass to hydrogen was compelling (given the infrastructure and expertise already in place), the case for a geneticist/biologist to develop new plants and new microbes that convert cellulose to fuels was not convincing.

The proposed economic development goals of creating two start-up companies by 2007 and relocating a company with 50 employees by 2009, while seemingly modest in economic impact, are in fact overly optimistic. A start-up company is typically based on new intellectual property (IP), and merely to be granted a patent takes considerable time, let alone finding a licensee or a venture capitalist to support the conversion of the IP into a product that a company can sell. Further, while relating hydrogen/South Carolina to petroleum/Texas catches one's attention, the parallel needs to be spelled out with more credible and impressive projected numbers on the long term economic impact.

The issue of biomass conversion efficiency needs to be clearly addressed from the standpoint of physics. The speaker quoted a 50% efficiency, but if this is really the case, this seems so attractive that it begs the question why this hasn't been done already. Some have claimed that, using today's technology, it actually requires more energy to produce hydrogen from biomass than is available from the hydrogen itself. If this is indeed the case, then there is a clear requirement for more research—as the Department of Energy is proposing in its renewable energy plan. The current efficiency of the process needs to be clearly understood and projections made on what can be done with new research and technology.

- RECOMMENDATION

This proposal involves some outstanding individuals, has some strong technical parts, and is well supported in certain aspects by existing organizations and infrastructure. USC has a core strength in this area and is building on this strength. A better case could have been presented for the economic development aspects of the proposal and for the basic physics and other issues underlying the proposed biomass research. Accordingly, the panel recommends that the catalysis endowed chair be funded (at a level of $3,000,000) but that the biomass endowed chair not be funded at this time. Depending on the success of the program, the remainder of this plan could be proposed in the future.

CLEMSON SUPPLY CHAIN MANAGEMENT $2,000,000

- DESCRIPTION

The proposal seeks an endowed chair in Supply Chain, Optimization, and Logistics for Clemson University at the Clemson Institute of Supply Chain Optimization and Logistics (CISCOL).

- STRENGTHS

Logistics/ supply chain management is an important area, accounting for about 10% of the U.S. economy, but only a small fraction of businesses believe that they have been successful in optimizing their supply chain.

CISCOL is an existing unit at Clemson, with 25 faculty from three colleges and seed monies from the colleges and the Vice President for Research. It provides an accessible portal to Clemson's expertise in operations research and management science. Since the existing program is strong, with faculty who are well recognized in the field, attracting a nationally recognized scholar, who will in turn attract outstanding postdocs and graduate students, is feasible.

In addition to CISCOL, Clemson is well positioned to be a leader in this area, as the University sits at the center of a major and fast developing network of manufacturers and suppliers in the I-85 corridor. The link between supply chain research and economics is direct. As an example, an executive (Mr. Ed Bergen) from one of the nearby industries—the aircraft engine rebuilding component of Lockheed-Martin—spoke directly to his need for modeling his processes/supply chain and stated his expectation of using CISCOL for research in this area. His unit currently employs 1500 people and a doubling of his sales would result in a 50% increase in employment.

The connection of the Institute with which the scholar will be affiliated to the Department of Industrial Engineering is important, as the area of supply chain management becomes more integrated into manufacturing processes.

South Carolina could expect significant, short-term economic benefit once the chair is filled and the program begins to grow. As suggested by the above comments from the Lockheed-Martin executive, companies are likely to support research and development programs at the university and the Institute's presence will be a strong selling point in attracting businesses to the region. Unlike some university investments which take time to provide benefits, this program should help the state almost immediately.

- WEAKNESSES

Clemson will not be the innovator in this area—similar programs exist at other universities—and there is little new in the program's approach to the area of supply chain management. Thus the novel research component in this proposal is less significant than the likely economic impact.

Aiming for a member of the National Academy of Engineering is probably an unrealistic goal unless there is considerable supplemental funding from the Clemson administration (this funding was committed during the discussion by the Provost and President) ; an "imminent" rather than an "eminent" scholar is a more practical goal, and one that will likely have a longer payoff for the university and the state. But if the resources are provided to meet the salary requirements of a distinguished senior researcher, it would certainly be to the Center's advantage to aim as high as possible.

The outreach activities of the center will not easily be limited to South Carolina, since much of the development in the region is in North Carolina and Georgia. In particular, the NSF-sponsored Center for Engineering Logistics and Distribution (CELDi), one of the NSF's Industry/University Cooperative Research Centers (IUCRC), is headquartered at the University of Arkansas and involves several other mid-western/southern universities. CISCOL and this new chair should seek linkages with CELDi.

No detailed plan was presented for obtaining the matching funds, but the Clemson administration spoke to its track record of obtaining the matching and, given the likely research funding from industry, acquiring the necessary matching funds seemed plausible to the committee.

- RECOMMENDATION

The Review Panel recommends full funding of this proposal ($2,000,000).

CLEMSON ELECTRON IMAGING $5,000,000

- DESCRIPTION

The proposed research center consists of an endowed chair for an electron microscopist and an associated laboratory with electron imaging and microscopy equipment.

- STRENGTHS

This center matches up well with existing research strengths in the university and with economic interests in the region including automotive research, biomaterials, polymers, thin films, and related microelectronics components. Some 52,000 people are employed in the materials-related industries in South Carolina. At Clemson, $5-6 million in extramural research exists in the $ 21M, 110,000 sq ft Advanced Materials Laboratory that was completed in August 2004. The existing equipment, all purchased since 1999, is valued at approximately $4-5M, including roughly $2M worth of donated equipment from Hitachi and Oxford instruments.

In the electron imaging facility, three full time staff are currently employed and Clemson is pledging to hire another two. The university also provides operating costs. In a plan revised from that presented in the original proposal, Clemson is proposing an annual operating fee for a university consortium of $50,000/yr which is comparable to that of similar consortia in other states. The maintenance contracts on the equipment are currently covered by Clemson. The review panel applauds this impressive commitment of personnel and equipment in establishing this facility.

In contrast to that anticipated originally, the university proposed in the oral presentation that the endowed chair would consist of a person whose research is in one of the basic science areas listed above, rather than a scientist who would focus on research in electron microscopy. The review panel strongly concurred with this revision. In addition, the Review Panel also suggests that biomaterials may be a strong area of need, especially in support of other drug discovery efforts in the state.

The proposers suggested that they might be able to recruit one of the top five people in the nation in materials for this chair. The review panel suggests that for such a recruitment, the university should pledge to fund the salary and the endowment income could then be used in support of the chair's research.

- WEAKNESSES

No matching funds are currently in place. The plan is to raise $5 million from the private sector. To date, the university has been very successful in raising industry support for the electron microscopy lab. There was some discussion about a membership fee from industry to support the chair, but this seemed far-fetched to the panel. Three industrial affiliates spoke to the value of the existing Advanced Materials Center both in terms of research (in particular impurities in materials of Borg-Warner) and in terms of education (seminars, classes, etc.).

Clemson also needs to construct an upgrade path for the electron microscopy lab to keep it at the state of the art. This is absolutely critical for the sustainability of the facility and the chair.

There was no mention of the new methods for 3-D imaging and dynamics in this evolving field. Also, the panel believes that a major opportunity exists at the nearby Oak Ridge National Laboratory for collaboration in electron beam imaging and neutron scattering for materials research.

Finally, the panel suggests that the intellectual property issues should be settled up front before this center and chair are fully established.

- RECOMMENDATION

The Review Panel recommends funding of this proposal in the amount of $5,000,000.

Part Four: Recommendations for Infrastructure

Advanced Broadband Networking. The Review Panel recommends that the SCHE (South Carolina Commission on Higher Education), the three senior research universities, and the South Carolina Division of the State CIO (Chief Information Office) work together to develop a scalable broadband network as an essential vehicle to support the rapid expansion of collaboration that is being generated by the Research Centers of Economic Excellence program.

The Review Panel did not have access to full information about current higher education networking in South Carolina. According to the Office of the State CIO, which manages communications for the universities, there is substantial capacity in place as well as plans to meet future needs with high speed Ethernet connections.

To illustrate the importance of the issue, typical "very high speed" connections to colleges and universities in the U.S. today are what is known as OC-3, or about 155 Mb/s. That seems a lot, but demand is changing very quickly. For example, a single HDTV video connection can use as much as about 20 Mb/s, or about one sixth of an OC-3. More dramatic, in the critically important area of shared instrumentation, a state-of-the-art MRI (Magnetic Resonance Imaging) device of the kind used for advanced life sciences research now outputs about 8 Gb/s. This is about 50 times an OC-3 line.

Improved networking is about more than just capacity. There is also the issue of what the telecommunications industry calls Quality of Service (QoS). When many applications share the same narrow network "pipe" (for example, video conferencing together with regular Internet traffic), there will be decreases in quality when there are sudden surges in use. For example, a medical education seminar using video conferencing could experience dropped frames or other

degradations. Quality problems such as this will make people unwilling to depend on networks—and therefore collaboration—as a means of improving research and education.

One way of responding to the capacity and QoS problem is to build a "dark fiber" network. In this case, the user acquires one or more pairs of fiber for exclusive use and employs Wave Division Multiplexing (WDM) equipment that permits rapid scaling of capacity by adding additional channels ("waves" or "lambdas"). This strategy also supports QoS by separating applications that might interfere with each other.

Dark fiber networks[3] also may have economic advantages. Once the core WDM equipment is purchased, adding capacity requires simply putting new cards in a chassis—as opposed to negotiating a new contract with a service vendor.

States that have already developed and deployed large scale comprehensive statewide networks of this kind are Ohio (Third Frontier Network) and California (CENIC). Connecticut hopes to have a similar system in operation this year or next. Others, with connections that are limited to major research universities, include Indiana and Oregon.

It is important to note that networks of this kind do not compete with private telecommunications services—they simply purchase privately provided goods and services (including fiber, equipment and perhaps also management services) in a different and more efficient way. Indeed, most experts agree that the advent of these higher education networks will increase demand for privately provided broadband services by demonstrating the power of new applications.

Dark fiber may not be the best choice for South Carolina. Planners will need to balance on the one hand the availability of fiber, and on the other the willingness of vendors to provide scalable services at costs that are reasonable over the long term. In any case, the Review Panel believes that the universities should consider a multi-phase strategy such as the following:

Phase 1

A task force representing Clemson, MUSC, and USC could:

- identify current resources;
- engage in capacity planning based on voice, video, and data needs projected by researchers and other collaborators;
- review best practices in other states and regions;

[3] Once the fiber is "lit," it is no longer dark. Even so, the phrase is commonly used to designate networks in which the user manages the fiber directly, rather than purchasing capacity from a vendor.

- identify available options, including joining existing regional consortia such as SRON (Southern Regional Optical Network), sponsored by SURA;
- identify a process to allow higher education, when appropriate, to procure telecommunications services directly from the private sector or not-for-profit consortia;
- develop a budget estimate; and
- recommend an optimal solution.

Phase 2

Members of the higher education task force could engage with SCHE and the State CIO to:

- modify draft recommendations as appropriate;
- develop funding, implementation, and operational strategies.

Computational Science. The Review Panel believes that South Carolina's research universities, in collaboration with its undergraduate institutions and perhaps also with K-12, should develop a collaborative program in computational science (CS). At least on the research end, the Review Panel believes that such an initiative is necessary to support high quality programs in a range of science and technology areas.

Computational Science and Drug Discovery

Historically, the bottleneck in drug discovery and early-stage development has been the identification of disease-related biological targets. Since completion of the human genome sequence project, the bottleneck has shifted downstream to target validation and the development of chemical compounds with drug-like properties. This led to the development and use of systems biology and computational science as major drug development tools.

Although most academic-based centers have sufficient systems biology expertise, very few have adequate computational science capabilities to compete favorably in the modern era of drug discovery and development. Much of the research needed for drug discovery including protein (drug target) modeling, binding site identification and characterization, and compound design can be accomplished using computational approaches.

A growing number of applications for endowed professorships at South Carolina's major research universities include drug discovery as a major topic. However, the lack of strong capabilities in computational science and the absence of an infrastructure that provides high-speed and high-bandwidth connections between the major universities present major obstacles in developing programs that can compete in this highly competitive environment. The Review Team recommends that the State of South Carolina consider investment in computational science and high-speed connections in order to provide the capabilities to allow the state's research universities to compete in this important and potentially very lucrative area of discovery.

Computational Science for South Carolina means more than just having adequate High Performance Computing (supercomputing) machines; it also requires a connected core of people who work at the frontiers of this exciting and rapidly developing area.

Computational Science (CS) is a fairly new

term.[4] Unlike Computer Science, which is primarily focused on computer technology, CS describes the *application of computing, especially high performance computing, to the solution of scientific and technical problems.* Computational scientists use computers to create mathematical models that help them simulate and understand the operation of natural and mechanical processes, as well as to visualize the operation and results of these models.

One well established example of computational science is weather forecasting, where vast amounts of data combined with sets of mathematical formulas in a computer program called a weather model are used to develop forecasts. These forecasts are far more accurate and timely than were possible before CS techniques were employed. Another important example from business is the use of computer models to simulate and test new products prior to manufacturing. The use of "virtual prototypes" sharply reduces or even eliminates the slow and expensive process of building physical prototypes.

The ability to model weather, new products, or other phenomena in a computer has unique advantages. For example, when used to simulate matter at the molecular level vast new opportunities are opened up for scientists. It allows researchers in the life sciences to see three-dimensional visualization of drug molecules interacting with viruses—the possibility of actually "seeing" how pathogens respond to therapy is a radical change in medical research. In materials science, molecular analysis is providing a wide new range of insights, and it was CS that made nanotechnology—the engineering of materials at a molecular level—possible.

The recognition of the economic importance of high performance computing and advanced computational science is growing. In its recent survey of 33 Chief Information or Technology Officers of major companies, the Council on Competitiveness found that 97% said their company could not function without high performance computing and computational science. Other nations also see the importance of CS. Japan has identified high performance computing and CS as one of the 10 technology fields critical to its competitiveness.

Technology Transfer. The Review Panel was concerned that each of the three universities has a separate, lightly-funded technology transfer operation. Given the potential benefits of scale in this important area, the Team's initial reaction was to recommend that the three operations be combined. It appears, however, that a similar objective may be achieved under the aegis of the South Carolina Research Authority in the form of its Research and Innovation Centers. The mechanism for improving technology transfer is, of course, within the purview of the state. But the Review Panel does want to emphasize its belief that active measures in this area are desirable.

[4] The text in this section draws on an Ohio Board of Regents/ Ohio Supercomputer Center "Idea Paper" on Computational Science. See www.osc.edu/obr .

Part Five: Conclusion

The Review Panel believes that South Carolina has an exceptionally strong program in the Research Centers of Economic Excellence. The investments made in the currently recommended programs, together with additional funds provided in the future, will produce extraordinary benefit for South Carolina.

Appendix: Important Documents

South Carolina General Assembly
CHAPTER 75.
SOUTH CAROLINA RESEARCH CENTERS OF ECONOMIC EXCELLENCE

SECTION 2-75-05. Short title; legislative intent.

(A) This chapter is known and may be cited as the "South Carolina Research Centers of Economic Excellence Act".

(B) The General Assembly finds that:

(1) it is in the public interest to create incentives for the senior research universities of South Carolina consisting of Clemson University, the Medical University of South Carolina, and the University of South Carolina to raise capital from the private sector to fund endowments for professorships in research areas targeted to create well-paying jobs and enhanced economic opportunities for the people of South Carolina;

(2) these endowed professorships should be used to recruit and maintain leading scientists and engineers at the senior research universities of South Carolina for the purposes of developing and leveraging the research capabilities of the universities for the creation of well-paying jobs and enhanced economic opportunities in knowledge-based industries for all South Carolinians;

(3) in communities across the United States in which better paying jobs and enhanced economic development in knowledge-based industries has flourished, the local or state government has created incentives and made a long-term commitment to public and private funding for a significant number of endowments for professorships in targeted knowledge-based industries;

(4) the South Carolina Education Lottery provides a source of funding and an incentive for the senior research universities to raise, in dollar-for-dollar matching amounts, sums from private sources sufficient to create endowed professorships;

(5) these endowed professorships should be awarded to the senior research universities through a competitive application process, provided that the competitive process must encourage the senior research universities to submit cooperative applications with one another as well as in cooperation with other institutions of higher education; and

(6) these endowed professorships, funded equally from the South Carolina Education Lottery and from other private sources, provide a foundation for the creation of centers of economic excellence.

Source: www.scstatehouse.net/code/t02c075.htm

South Carolina Research Centers of Economic Excellence
Summary of Purposes and Goals

During the 2002 legislative session, the South Carolina General Assembly passed the *South Carolina Research Centers of Economic Excellence Act*. With an allocation of $30 million in lottery funds, to be matched on a dollar-for-dollar basis with non-state funds, the General Assembly established a competitive grants program to award to South Carolina's three research universities funds endowed professorships in areas that will enhance economic opportunities for the state's citizens.

The Act created the *Centers of Excellence Matching Endowment*, which is to be funded annually by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200 million by 2010. Moreover, the Act established the *Research Centers of Excellence Review Board* consisting of twelve members; the Commission on Higher Education provides staff assistance to the Board. The *Board* is responsible for awarding state matching funds, for oversight and operation of the fund, and for various accountability requirements established in statute for the program.

The legislation establishing this program is very explicit as to its purpose:

> "It is in the public interest to create incentives for the senior research universities of South Carolina consisting of Clemson University, the Medical University of South Carolina, and the University of South Carolina to raise capital from the private sector to fund endowments for professorships in research areas targeted to create well-paying jobs and enhanced economic opportunities for the people of South Carolina."

The legislation goes on to say that the endowed professorships should be "used to recruit and maintain leading scientists and engineers at the senior research universities of South Carolina for the purposes of developing and leveraging the research capabilities of the universities for the creation of well-paying jobs and enhanced economic opportunities in knowledge-based industries for all South Carolinians."

Made explicit largely through its title is the intent of the program to create a critical mass of senior researchers around whom a Center of Excellence can be built. Such a Center will include other senior and junior faculty, graduate students, and public/private partnerships with business and industry. Through research and its eventual application, the clear expectation of the act is that job creation and other economic stimuli (e.g., patents, licenses) will result over time.

The legislation acknowledges the success of other communities in creating economic opportunity through knowledge-based industries by providing through their state or local governments incentives and a long-term commitment to public and private funding for "a significant number of endowments for professorships in targeted knowledge-based industries." Thus, the program's stated intent is to provide $30 million from lottery funds, to be matched by the institutions on a dollar for dollar basis by "private" funds, each year through the year 2010.

The legislation stipulates that awards are to be made through a competitive application process which encourages collaboration among the three research institutions as well as cooperation with other higher education institutions. Funding decisions are to be made by a nine member Research Centers of Excellence Review Board, three members of which are appointed by the Governor, the President Pro Tem of the Senate, and the Speaker of the House respectively.

Source: http://www.che.sc.gov/ResearchCtr/Program_purposes_and_goals.doc

South Carolina Research Authority (SCRA)

Technology Solutions

At SCRA and our affiliated institutes, we develop technology solutions to meet the complex needs of customers in government and business.

To do that, we assemble multi-organization teams that can include governmental groups, universities, major corporations, technology companies, consultants and our own staff of specialists in disciplines ranging from computer science to advanced metallurgy.

Working with these collaborative teams, we identify applicable technologies and use innovative strategies to adapt them to client needs. In addition, our projects often make use of SCRA capabilities to ensure that customers are able to implement and use the new technologies effectively.

In our 21 years of operation, SCRA and our affiliated institutes have emerged as international leaders in this unique field of consortium management, attracting more than $68 million in annual revenue. Current customers include groups within the Department of Defense, Department of Justice, Department of Transportation, Department of Energy, and Department of Commerce as well as private industry, medical centers, state and regional transportation departments, and security/law enforcement agencies.

SCRA also works to enhance research infrastructure within South Carolina. We support the efforts of faculty at state academic centers to secure project grants and build new capabilities, and we manage a system of research parks that attracts technology companies. These parks are now home to 40 technology-oriented firms employing nearly 6,000 people.

Source: www.scra.org

Information on the Centers of Innovation is at http://www.scstatehouse.net/sess116_2005-2006/bills/3794.htm

Health Sciences South Carolina

Health Sciences South Carolina is a public-private collaborative partnership between two of South Carolina's leading universities, the Medical University of South Carolina (MUSC) and the University of South Carolina (USC), and the state's largest health systems, Palmetto Health and Greenville Hospital System.

The mission of Health Sciences South Carolina is to advance health sciences research, education, and public health in the Palmetto State. Each of the four partners has agreed to invest $2 million per year for 10 years in health sciences research, an investment of $80 million. Matching dollars from the South Carolina General Assembly through the Life Sciences Act raise the total investment to $160 million.

Since the collaboration was formed in April 2004, GHS has made a series of announcements made possible in part by Health Sciences South Carolina. Click the links below for press releases related to this historic initiative:

Source: http://www.ghs.org/frame.php?id=10056

South Carolina
Research Centers of Economic Excellence
Review Panel Report

May 31, 2006

In May 2006 a Review Panel of seven consultants convened in South Carolina to review and assess the merits of Endowed Professorship proposals submitted to the Research Centers of Economic Excellence Review Board during the 2005-06 funding cycle.

This document presents the findings and recommendations of the Review Panel and is organized as follows: Part One provides an overview of the Endowed Chairs program; Part Two provides general findings and recommendations from the Review Panel; Part Three offers suggestions on improving program operation. Part Four describes the Panel's recommendations for funding based on their review of the 2005-06 proposals; Part Five provides Panel recommendations for the development of infrastructure supportive of the Endowed Chairs program; and Part Six offers a summary conclusion from the Panel.

Part One: Program Overview

Program Description and History. During the 2002 legislative session, the South Carolina General Assembly passed the *South Carolina Research Centers of Economic Excellence Act*. With an annual allocation of up to $30 million in lottery funds, to be matched on a dollar-for-dollar basis with non-state funds, this competitive grants program awards to South Carolina's three research universities funds to establish Endowed Professorships in areas that will enhance economic opportunities for the state's citizens. The program is funded by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200 million by 2010.

Awards are made through a competitive application process which encourages collaboration among the three research institutions and with other higher education institutions in the state. Funding decisions are made by a nine-member Research Centers of Excellence Review Board, three members of which are appointed by the Governor, the President Pro Tem of the Senate, and the Speaker of the House respectively.

Current Program Status. The program is currently in its fourth year of soliciting and reviewing proposals from the state's three research universities. The 2005-06 funding cycle initially represented 11 proposals; two were withdrawn prior to the Review Panel's visit.

Over the last three years the Review Board has approved funding for 24 research proposals from USC, MUSC, and Clemson University and their

partner-institutions, totaling $100 million in state lottery funds. To date over $33.6 million in lottery funds has been drawn down and distributed to the institutions, and the institutions report $78 million in matching fund pledges, of which $44.6 million has been received.

The 24 Board-approved Research Centers represent a diverse palate of research fields: Automotive Research and Vehicle Electronic Systems (associated with the International Center for Automotive Research, or ICAR), Supply Chain Optimization and Logistics, and Historical Restoration at Clemson University; Nanotechnology, Hydrogen Storage and Hydrogen Fuel Cell Sensors, and Travel and Tourism Technology at the University of South Carolina – Columbia; and Proteomics (protein research), Marine Genomics (genetic research), Brain Imaging, Regenerative Medicine, Vision Science, Neuroscience, Patient Safety and Clinical Effectiveness, and Cancer research at MUSC. Partner institutions for several Centers include the College of Charleston and Coastal Carolina University. Several Centers also represent collaborative efforts among the state's three research universities.

The program is currently in its fourth year. The 2005-06 funding cycle included 9 individual and collaborative proposals:

Institution(s)	Project Title	Amount Requested	Chairs	
Clemson	Molecular Genetics	$5 million	1	
Clemson	Fiber-Based Materials	$4 million	1	
Clemson/MUSC/USC	Molecular Nutrition	$6 million		
	Nutrigenomics	*(Clemson $2M)*	1	
	Molecular Physiology	*(MUSC $2M)*	1	
	Molecular Kinesiology	*(USC $2M)*	1	
USC	Materials Physics	$4 million	1	
~~*USC*~~	~~*Tissue Engineering*~~	~~*$3.5 million*~~	~~*1*~~	*Withdrawn*
USC	Oxide Fuel Cells	$3 million	1	
USC/MUSC	Childhood Neurotherapeutics	$6 million	3	
USC/MUSC/Clemson	Healthcare Quality	$6 million	2	
MUSC/USC	Molecular Proteomics	$5 million	2	
~~*MUSC*~~	~~*Cell Based Therapy*~~	~~*$5 million*~~	~~*1*~~	*Withdrawn*
MUSC/USC/Clemson	Stroke	$5 million	4	
	9 Proposals	**$44 million**	**18**	
	Available 2005-06 funding	**$20 million**		

Evaluating the Proposals. The process of assessing the quality and viability of each proposal proceeded in two phases. The first phase involved submitting the proposals via e-mail to external reviewers to determine the technical merit of each research project. The goal of this process was to obtain a minimum of four technical reviews: two from reviewers recommended by the institution submitting the proposal, and two from acknowledged experts in the field who have not been recommended by the submitting institution. Reviewers were asked to assign points to the proposal in each of four categories: Scientific and Technical Merit (up to 40 points); Approach, Process, and Execution (up to 25 points); Innovation (up to 25 points); and Infrastructure, Support, and Collaboration (up to 10 points). The maximum point total is 100.

The second phase of review involved assembling a team of consultants ("Review Panel") to visit the campuses, attend formal presentations by the Principal Investigators submitting the proposals, and meet with institutional leaders. Prior to their arrival in South Carolina, the Review Panel received and reviewed the proposals in their entirety, as well as the phase one technical reviews. Although the Review Panel carefully weighed the technical merits of each proposal to determine base line quality and competitiveness, the primary focus of their subsequent assessment was upon the degree to which each proposal was consonant with institutional mission and the potential economic contribution of each project to the state of South Carolina.

Further, each proposal was assigned a lead reviewer and a secondary reviewer. The role of the lead reviewer was threefold: 1) to serve as the effective chair of the Panel for that proposal, including taking the lead in formulating questions; 2) leading the Panel's internal discussion and ranking of the proposal during deliberations; and 3) drafting the narrative section required for the final report. The second reviewer provided reinforcement and support for the lead reviewer assigned to each proposal.

At the conclusion of each day's campus visits the Review Panel convened to discuss the proposals and begin drafting a preliminary report. During subsequent weeks the Panel, under the guidance and direction of Panel Chair Walters, communicated via telephone and e-mail to arrive at final conclusions and funding recommendations. The 2005-06 Review Panel included four returning consultants and three new Panel members:

Name	**Title**	**Institution**
Garrison Walters, Ph.D. (Chair, returning)	Interim Chancellor/ Vice Chancellor for Academic Affairs and Economic Advancement/	Ohio Board of Regents
Tony Waldrop, Ph.D. (returning)	Vice Chancellor for Research	UNC – Chapel Hill
James Roberts, Ph.D. (returning)	Vice Provost for Research	University of Kansas

Name	Title	Institution
Jack Burns, Ph.D. (returning)	(Former) Vice President for Academic Affairs & Research	University of Colorado
Richard Linton, Ph.D.	Vice President for Research & Graduate Studies	University of Oregon
Charles O. Rutledge, Ph.D.	Vice President for Research	Purdue University
Laura S. Levy, Ph.D.	Associate Senior Vice President for Research	Tulane University

Part Two: General Findings and Recommendations

The Research Centers of Economic Excellence 2005 Site Review Panel conducted a visit to Charleston (MUSC), Clemson (Clemson), and Columbia (USC) on May 8-11, 2006. Thanks to the excellent work of the staff of the South Carolina Commission on Higher Education, the participating universities, and the many collaborating organizations, the visit was very well-organized and highly informative. Taken together with the extensive documentation provided in advance, the Review Panel believes that it had access to sufficient information to make recommendations for funding. Those recommendations are provided in detail in Part Four of this report.

The extensive documentation on the Research Centers program, together with the opportunity to interact with university personnel and representatives of affiliated organizations, also provided the Review Panel with an opportunity to comment on the overall purpose, structure, and foundations of the program.

The Research Centers of Economic Excellence is One of the Nation's Best Programs

The Review Panel again applauds the state of South Carolina for its vision in developing and implementing the Research Centers of Economic Excellence Program. As the United States moves into what the writer Thomas Friedman calls a "flat world," where knowledge is the principal currency, a state cannot make a better investment than in its research institutions.

Investing in people on the leading edge of knowledge is by far the best economic development strategy a state can have.

A simple illustration of the value of knowledgeable people can be found in the example of Google, the multi-billion dollar search engine company.

Google was founded in 1996 by two Stanford University computer science doctoral students. Sergei Brin (who came from Russia via Maryland) and Larry Page (from Michigan) were attracted to Stanford by its top quality computer science program, and once in Palo Alto found themselves in a cauldron of ideas and innovation fueled by the university's array of world-class science and engineering programs.

Talent attracts
When semiconductor giant Intel announced a few years back that it was going to add a new R&D facility in Austin, a reporter asked Albert Yu, then head of Research for Intel, if the location was chosen to be near customers such as Dell Computer. Yu replied that Intel didn't need to be near its customers, and stated that the decision was made because "Austin has become a high-tech center, and we wanted to be near the University of Texas and the talent coming out of there."
EE Times, 9/24/98

The idea of an Internet search engine was directly assisted by Stanford,[1] and Google became a privately held company in 1998. By 2005, its revenue exceeded $7 billion per year.

Google is a true Internet company and its headquarters could be located any place in the world that has decent telecommunications resources (Google's estimated 100,000 plus servers are spread across the globe). Given this mobility, one has to ask why the company remained in an area with an extremely high cost of living, serious traffic congestion, and very high taxes?

The answer is simple—Google is a company that depends on innovation[2] and it knows that the San Francisco Bay area is a hotbed of talent. The same factors that brought its two founders to the region keep the company there.

A similar example can be found in the advanced electronics sector. Stanford and UC-Berkeley are like giant vacuum cleaners, pulling in the best and brightest undergraduate and graduate students from all over the world. As a result, the Bay Area is sprinkled with large R&D facilities operated by semiconductor companies whose headquarters and manufacturing facilities are elsewhere--IBM's Almaden Research Center is one example. Again, the reason these high wage operations are where they are is to be close to the two universities' outstanding graduates. Simply put, talent attracts.

As noted in last year's report, South Carolina's superb strategy of investing in carefully focused clusters of talented people should begin to bear fruit quickly.

[1] Much is made, and appropriately so, of Stanford's support for entrepreneurs. It shouldn't be forgotten, though, that a necessary precursor for this is the university's standing as a center of knowledge creation. Stanford's total research of over $603 million in 2003 ranked it eighth in the country. Total academic R&D for South Carolina in 2002 was about $400 million.
[2] Google's famous policy of encouraging engineers to spend twenty-percent of their time on innovation is reported to be the source of many of their new products and services.

In the short-term (one to three years after activities begin) the program should increase the state's flow of federal and industrial research. This is a very considerable economic benefit to South Carolina: according to the Association of American Universities, every $1 million in total research expenditures supports 36.5 high-value, high-wage R&D jobs.[3]

For the medium term (three to seven years), many of the proposals envision the creation of start-up companies. This will certainly happen to some extent, though the Review Panel emphasizes that this is an uncertain measure of success, dependent on an array of variables. In many fields, a more likely outcome in the medium-term is the attraction and expansion of existing companies. As the Intel example demonstrates, outstanding research centers are a powerful magnet for technology companies.

In the long term, the Research Centers of Economic Excellence Program, if sustained and complemented with other investments in education, should strengthen the perception of South Carolina as a place with an active role in the knowledge economy. This, in turn, will attract educated people to the state—including in areas not directly connected with the Research Centers—and also encourage more, and especially more of the best, graduates to stay.

This investment in educated people is similar to what North Carolina began to make over forty years ago. The other Carolina's success will not be easy to emulate. Progress will not be linear or fast. But the alternative, not trying to compete in the knowledge economy, is unacceptable.

In summary, the Research Centers of Economic Excellence is an exceptionally well-conceived program. The investments will have significant short and medium term benefits, and will help create a "buzz" about the state, that sense of being on the leading edge that makes bright people want to stay and others want to come. The Review Panel believes the program should be continued past the 2010 deadline and, if possible, expanded before then.

Additional Key Factors in South Carolina's Path to Success

Strong Universities

The 2006 Review Panel concurs with the Review Panels from prior years' visits on the quality of South Carolina's research institutions. The state has reason to be proud of their accomplishments, and the Review Panel wishes to emphasize some of the university successes that are especially important to the Research Centers program.

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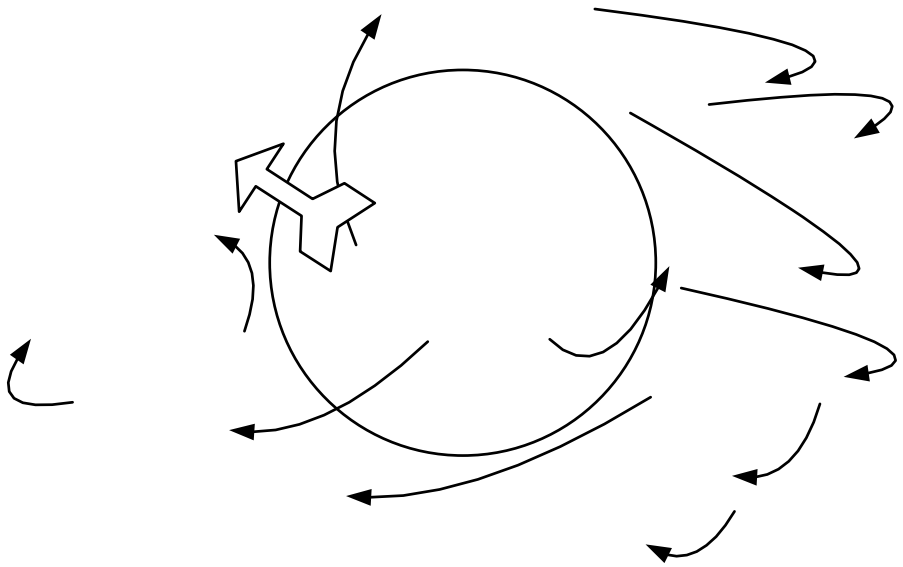
[3] Derived from data at: http://www.aau.edu/resuniv/FY97Employ.html .



Leadership

Implementing complex plans requires sophisticated guidance, and the Review Panel believes that South Carolina's research universities have excellent leadership overall, very definitely in the areas of research and economic development. Members of the Review Panel who have participated since the first years are particularly struck by the ability of these leaders to design and implement strong strategic planning processes—our view is that South Carolina really stands out in this critical area.

Strategic Planning

As noted in last year's report, virtually every organization today employs some form of strategic planning, and the attendant processes have produced many fine words. Unfortunately, implementation in the real world is often lacking.

But strategic planning is an area where South Carolina stands out. The three universities have clearly gone beyond planning and are implementing specific plans and making real, tangible progress. The universities began their planning at different times and as a result are not all at the same level of implementation, but the Review Panel believes that all plans have the potential to be highly successful.

A central element of the strategic planning at the three South Carolina universities is focus—putting a disproportionate share of resources on a few key areas where the university has a chance to excel. In today's complex research

environment, where scale is an increasingly important factor in achieving the critical mass of talent, facilities, and equipment, focus of this kind is essential for all but a handful of the largest and most comprehensive institutions.

A key point about the universities' decisions on where to focus is that strengthening the economic development of South Carolina (while also improving the quality of life for its citizens) has been the driving criterion.

Institutional focus does carry some risk. Isolated programs can have difficulty in securing the resources needed to be competitive. Also, shifting the necessary funds at a small or even a medium-sized institution can create a burden for other programs and threaten the university's ability to offer the needed array of undergraduate degrees. Multi-institutional collaboration is an effective vehicle for offsetting these problems, and, as discussed in the next section, the Review Panel believes that this is another significant South Carolina strength that is anchored in the Research Centers of Economic Excellence Program. Indeed, the universities have come far enough that it might make sense for them to undertake a joint strategic planning effort in the area of research/graduate education.

Collaboration

The Review Panel was very impressed with the level of collaboration among South Carolina's three research universities. As with the institutional strategic planning, there is a high level of substantive activity that transcends the rhetoric typically encountered in most parts of the country. Team members who have been present in earlier rounds note that there has been considerable progress in this area.

Particularly praiseworthy are the decisions to create a joint school of pharmacy between USC and MUSC and the creation of the Health Sciences South Carolina concept.[4] These are major undertakings that will require extensive administrative energy and—not to be overlooked—patience. Major initiatives of this kind, taken together with the array of activities in other areas of life sciences, travel/tourism, and more, suggest that the initials "SC" could stand for "Spirit of Collaboration" as well as South Carolina.

The Review Panel is pleased that there is progress in advanced networking, something that could be described as the circulation system of the collaborative corpus. Part Five offers some comments and suggestions on the process.

[4] A brief description is included in the Appendix.

Part Three: Suggestions on Improving Program Operation

Although the Review Panel has been very impressed with the structure and operation of the Research Centers of Economic Excellence Program, the experience of the last few years provides some ideas on how the program could be improved.

- The Review Panel believes that each center should have a vision statement at the front of the proposal—not just for the chair or chairs, but for the center as a whole. This vision statement should be practical and operational, not abstract. The statement should speak to how the center will function for the state's economy, who its competitors and how it will be organized. This latter part should carefully specify the role of the chair or chairs (see below).

- The Review Panel encourages the universities to think carefully about the role the endowed chair holder will have in the center. In many cases, the Review Panel believes that the proposers are thinking of the chair holder as a jack of all trades, handling program administration, outreach, technology transfer, etc., in addition to being the core of knowledge creation and talent attraction. While a chair holder might have multiple roles, the manifold expectations the Review Panel has seen in many cases are unrealistic. The *center* should be comprehensive; the chair holder should have a focused and limited role.

- Descriptions of collaborations should be more detailed and more specific. In particular, the Review Panel would like to know if the participants already have a track record of working together. The whole point of a collaboration is adding value, and the proposal should be very precise as to how this will happen—often, interdependence is an important indicator of an effective collaboration.

- The Research Centers of Economic Excellence Program is now at a point where the track record is relevant. Next year's Review Panel should have evidence from each university on the status of previously awarded chairs, included data on grants, technology transfer, etc.

Part Four: Recommendations for Funding

The Review Panel has provided three general rankings for the proposals it reviewed:

Category 1, for immediate funding.

The Review Panel believes that programs listed here are already of high quality, have clearly defined goals and objectives, have most of the key resources for success in place and, if awarded one or more endowed chairs,

should find the needed match reasonably quickly and move quickly to greater success. Proposals in this category are *not* rank ordered.

Category 2, meritorious, but with one or more significant failings that could be remedied. Resubmission is encouraged, but should require a new proposal and some further external review by experts in the field.

These proposals are similar to those in Category 1 in many ways but require at least one significant change prior to being funded. The Review Panel has tried to state clearly the change or changes that are needed, but does not believe that funding should be provided without further external review to determine whether the problems have been resolved. Proposals in this category *are* rank ordered.

Category 3, having serious or structural flaws. Resubmission is not encouraged without important re-conceptualization and clarification that would be equivalent to a new proposal.

The Review Panel believes that these proposals require substantial rethinking and would not recommend funding even if revised. Instead, new proposals could be advanced in the next competition. Proposals in this category are *not* rank ordered.

Recommendations on the Individual Proposals

Category 1 - Recommended for Immediate Funding- (Total amount $20,000,000)

The Review Panel did not assign a ranking to proposals within this category.

Clemson/ Advanced Fiber-Based Materials - $4,000,000 Requested and Recommended

- DESCRIPTION

This proposal requests funding for an endowed professorship in advance fiber-based materials to expand Clemson's strength in materials research.

- STRENGTHS

Clemson has a number of strengths from which to build a nationally leading center in advanced fiber based materials. Until Dr. Richardson came to Clemson to lead the School of Materials Science and Engineering, these strengths appear to have been somewhat isolated pockets that lacked focus. She has provided the strong leadership and focus so that Clemson can now propose this endowed chair.

Having a prestigious NSF Engineering Research Center in materials science is a major discriminator for Clemson. It is crucial that the ERC be a major part of the overall strategy for attaining unquestioned national leadership.

Support from industry is impressive, and industry is looking to Clemson to conduct research for them. The significant presence of the textile industry in South Carolina is a real plus; while once considered dead, it is actually flourishing.

The university has the necessary space and equipment to support the proposed endowed chair.

Clemson will distinguish itself from other universities in materials research by providing an integrated solution. Dr. Richardson has analyzed the other programs and says that Clemson is unique in being able to go "all the way through the supply chain." They can go from the polymer to the fiber.

This proposal fits neatly into Clemson's strategic plan; advanced materials represents one of the eight research focus areas.

The educational impact of adding this endowed chair should be high. Already graduate students from the School of Materials Science and Engineering are working in other departments.

- WEAKNESSES

With the hiring of the proposed endowed chair, existing research strengths, and the leadership of Dr. Richardson, Clemson will have all the pieces in place to make the university and South Carolina an international leader in this area with one possible exception. It will be unfortunate if all of these strengths are not brought together into one organized research and economic development center, possibly a statewide center. While there are unique organizational constraints imposed by the NSF on Engineering Research Centers, for example, there are still ways that the ERC could be integrated into a center and become fully part of such a center when it graduates. Bringing all the efforts together in a center will also be a basis for the important partnerships with industry that are essential to the success of this effort. This is a real opportunity for Clemson and for South Carolina.

- RECOMMENDATION

The external review committee recommends full funding ($4,000,000) for this proposal.

MUSC - Center for Molecular Proteomics in Cardiovascular Disease Prevention and Treatment - $5,000,000 Requested and Recommended

- DESCRIPTION

This proposals requests funding for two-three endowed professorships to support a very well established program focused on chronic heart failure. Cardiovascular disease is a major problem in South Carolina; 36 South Carolinians die of cardiovascular disease each day. The proposed COEE has several goals:

1. Develop measurement systems to detect blood markers (diagnostic protein signatures) for early indication of heart failure;
2. Relate diagnostic protein signatures to clinical outcomes;
3. Development of therapeutic management strategies;
4. Create a statewide network to develop, test and improve clinical care of heart failure;
5. Transfer technology into new South Carolina industries.

- STRENGTHS

This is an outstanding proposal designed to build upon an already well-established research program. The proposed COEE will be led by Dr. Michael Zile, the Charles Ezra Daniel Professor of Medicine at MUSC. Dr. Zile and his collaborators have already established a strong linkage between specific blood proteins and cardiac remodeling that is indicative of heart failure. This hypothesis driven research not only has the immediate value of commercialization of identified proteins as biomarkers but it will also lead to numerous other hypotheses that can be tested and the results of this research exploited for further economic development. The faculty who are in place are excellent as indicated by their funding records and publications. The proposed chairs to be recruited are to be senior translational scientists with one located at MUSC and the other one or two to be located in the upstate and midlands.
The most impressive strength of this proposed is its potential for yielding an economic impact in the short-term. Dr. Zile and his colleagues are already in discussion with Ortho Clinical Diagnostics about their concept for a biomarker testing system. Such a device is envisioned as a desk top, office instrumentation which is a simple and inexpensive method for measuring the marker proteins. The measured protein levels will be used to create an individualized risk profile for development of chronic heart failure. MUSC has already filed two patents to protect the associated intellectual property.

- WEAKNESSES

There are no major weaknesses associated with this proposal. It was acknowledged by Dr. Zile that there is always the possibility that the blood proteins to be focused upon will not prove to be the concrete markers he proposes for the diagnostic testing. However, he has clearly thought about other markers to examine if this occurs. The same methodology would be applied for other marker proteins.

- RECOMMENDATION

The external review committee recommends full funding ($5,000,000) for this proposal.

USC - Oxide Fuel Cells - $3,000,000 Requested and Recommended

- DESCRIPTION

This proposal requests funding for an endowed professorship to expand the University of South Carolina's strengths in solid oxide fuel cell research and technology development.

- STRENGTHS

This COEE will build upon the already impressive and nationally prominent programs in hydrogen fuel cells at USC. The university has already won a highly competitive NSF-I/UCRC for fuel cells. USC has made significant investments in faculty, students, and infrastructure to build a world-class program. With this additional endowed professorship in oxide fuel cells, it will reach an important critical mass and leadership threshold. Strategically, this proposal is part of the Future Fuels research direction, one of four research directions that USC has identified through a thoughtful process.

Currently, the fuel cells program has numerous collaborations with companies such as BASF, GM, and John Deere; international partnerships with Korea, Canada, and Israel; and funding from the NSF, NASA, South Carolina D.O.T., and FujiFilm. The university has committed wonderful new laboratory space in the new Engineering Building on the Innovista campus. Industry is ahead of academia in fuel cell technology, but it is important for academia to build strength. USC is poised to do just that.

The educational impact should be high. There are very few programs in the nation training students in this emerging area which will be critically important in solving the U.S. energy crisis. These USC students will be in high demand.

A local USC/Columbia Fuel Cell Collaborative has formed and invested $30 million so far in research and technology development. Six spin-off companies have been built around USC technologies in fuel cells.

The university addressed the one concern of the reviewers and our review committee by identifying an impressive candidate for the endowed chair. He is a member of the National Academy of Engineering, is a recognized leader in oxide fuel cells, and will bring important national visibility to USC's program if he were to be chosen for this Chair. He is the catalyst to drive this program to success. His presence combined with current strength should make USC one of the top academic programs in the country in fuel cell technology.

Bringing all the USC fuel cell efforts into a single center organization that will form the basis of the all-important partnerships with industry and others is essential to the success of this effort. The center organization combined with the COEE Chair, space, equipment, and other support bodes well for the future of fuel cell technology in South Carolina.

- WEAKNESSES

A few minor points are worth noting. First, USC needs to be very careful in mitigating potential conflicts of interest in co-locating industry with basic academic researchers working on fuel cells in their new Innovista facility. Second, the technical challenges to bringing oxide fuel cells to a commercially-viable stage will be considerable and contain risk. Patience and continued investment will be required by USC. Third, the panel wonders if the total

package from the endowment and the cost-match from the University will be sufficient for this solid oxide fuel cell program to achieve its full potential.

- RECOMMENDATION

The external review committee recommends full funding ($3,000,000) for this proposal.

USC/MUSC – South Carolina Research Center of Economic Excellence in Childhood Neurotherapeutics - $6,000,000 Requested and Recommended

- DESCRIPTION

This is a proposal seeking the endowed professorships in the following areas of research: (1) Child and Adolescence Neurochemistry at USC; (2) Neurodevelopmental Dysfunction at MUSC; and (3) Translational Therapeutics at Greenville Hospital with an academic appointment at USC.

- STRENGTHS

This proposal addresses the important problem of neurological disorders in children. According to a South Carolina Public Schools report, children with disabilities represent 14 percent of school-aged children. The approach taken in this project reflects recent advances in pharmacogenetics, metabolic disorders, and neuroinflammatory diseases. It has the advantage of transferring innovation in the fundamental understanding of the disorder directly to the benefit of patients suffering from the various diseases.
The investigators make a strong case for the economic development impact of the COEE. A multicenter clinical trial is already being planned to evaluate the effect of N-acetyl cysteine in cerebral palsy patients.

The project has strong leadership now and it is expected to continue with the addition of the new endowed chairs. The institutional support for this project is quite strong. The Donald A. Gardner Family Center for Developing Minds specializes in evaluating and monitoring children with developmental disorders. This comprehensive specialized program at Greenville Hospital's Children's Hospital is one of the largest in the country. The endowed chair based at this hospital will conduct translational clinical research suggested by the research of the endowed chairs devoted to fundamental basic research. This will yield Phase I and early Phase II clinical trials.

- WEAKNESS

The major concern with this project is their ability to recruit suitable candidates for these positions in the near future. This field of research is moving very quickly and it is essential that the positions be filled as soon as possible.

- RECOMMENDATION

The review panel recommends full funding of this proposal for three endowed chairs ($6,000,000).

Clemson/ USC/ MUSC/ SCRA – South Carolina Research Center of Economic Excellence in Molecular Nutrition - $6,000,000 Requested - $2,000,000 Recommended

See also: Molecular Nutrition: Molecular Physiology and Molecular Nutrition: Molecular Kinesiology in Category 3, below.

- DESCRIPTION

This proposal was submitted by Clemson, USC and MUSC for three endowed professors in the areas of nutrigenomics molecular nutrition and molecular epidemiology. The long-term vision is to establish the South Carolina Center of Economic Excellence (COEE) in Molecular Nutrition as the foremost center for the creation of scientific information on energy balance and the pathogenesis and treatment of obesity.

- STRENGTHS

This proposal addresses obesity, an area of major health importance, especially in the State of South Carolina. The proposal is clearly written and its intent, scope and design are well articulated. If the aims of the proposal are achieved, this activity would have a significant impact on the quality of life in South Carolina through enhancement of nutrition-related technologies. This would favorably position South Carolina for a leadership position in the United States in addressing the problem of obesity. The three areas selected for endowed professorships are appropriate for the state of knowledge as it exists today. It is very encouraging that the three institutions have agreed to commit funds for chairs and have outlined a plan for cooperation and future collaborations. The holistic approach involving genetics, optimization of food sources, dietary recommendations and behavioral modification focusing on physical activity could make very important contributions to our understanding, prevention and treatment of obesity. Another strength is the extremely strong support from the South Carolina BioIndustry Advisory Committee.

- WEAKNESSES

A concern is whether this concept will be fully developed. The recruitment of people for the endowed chairs is important not only in regard to scientific expertise but in their willingness to encourage collaboration and cooperation with each other. Each of the three focus areas is quite broad and the projects of the center need to be linked across the three areas of expertise.

If active leadership is not exerted, the three areas could develop with no relationship to each other. There needs to be an organizational process that would force the three areas to be developed in collaboration. One approach would be to engage in short-term projects that would connect the three areas of focus. This would not only promote future collaboration but it would also demonstrate to the various stakeholders the value of the concept of this project. Another approach of promoting collaboration across the three areas would be to develop specific hypotheses that would link the three focus areas. Projects that test these hypotheses would also further develop the concept of the COEE. It was mentioned that one of the endowed chairs would be the scientific director.

How would this person be selected and what would be the responsibilities and expectations of this position? It was also mentioned that the South Carolina Nutrition Research Consortium (SCNRC) will assist the endowed chairs in implementing statewide research programs. It is not clear how this would work. What is the role of the SCNRC in the administration of the center that supports the three areas of research concentration?

The idea for the endowed chair in Nutrigenomics at Clemson addressing the effects of plant foods and dietary supplements on gene expression in obesity was much better developed than the concepts supporting the other two endowed chairs. The upper administration at both MUSC and USC supported their participation in this center but both noted that unlike the other proposals, this proposal resulted from discussion among the faculty. The absence of upper administration leadership may explain the relative lack of coordination of the three universities in bringing these three focus areas of this project together.

- RECOMMENDATION

The review panel recommends that partial funding of $2 million be approved to support the endowed chair in Nutrigenomics at Clemson and that the person selected for this position be given the responsibility for directing the COEE. The scientific director could then work with appropriate faculty of MUSC and USC to further develop the areas in molecular nutrition and molecular epidemiology with the prospect of obtaining funding for endowed chairs in these areas at a later time.

Category 2 - Meritorious, but with need for improvement and re-review before recommendation for funding.

Proposals in this category are listed in the priority order determined by the Review Panel.

MUSC/ USC/ Clemson - Center of Economic Excellence in Stroke - $5,000,000 Requested

- STRENGTHS

Important Need. Stroke is the third leading cause of death and the leading cause of disability in the United States. South Carolina leads the nation in the incidence of stroke due to the increased presence of risk factors in the population. There are greater than annual 3,000 deaths from cerebrovascular disease, and the estimated annual costs are over $400 million. A single FDA-approved drug for therapy (R-tPA) is on the market.

Well-Defined Mission. The purpose of the Center for Economic Excellence in Stroke is to strengthen clinical and basic research, identify new therapeutics for the treatment and prevention of stroke, and commercialize these new therapeutics through biotechnology and pharmaceutical companies. The support of three endowed chairs in basic and translational stroke research

would enhance the research programs, primarily at the Medical University of South Carolina (MUSC) and the University of South Carolina (USC).

Enhanced Biotechnology Company Ties. The program could accelerate the expansion of SC companies with an interest in neurological disorders (e.g. Neurological Testing Service, Applied Neurotechnology, CureSource, and Alpha Genesis).

Significant Direct Effects. The direct effects from the endowed chairs would be the generation of research dollars through grants from the National Institutes of Health (NIH) and clinical trials, which would raise $10 to $15 million for fiscal years 2005–2010, inclusive. Funds will be also used to train individuals (pre-, post-doctoral, and clinical fellows in the basic and clinical sciences) in the field of stroke.

Extensive Infrastructure at MUSC and Neuroscience Department. Basic infrastructure is in place for an active program to help reduce the risks or the effects of acute and chronic stroke. The program would utilize the new CoEE in Drug Discovery, providing high throughput screening and assay development capabilities. Over $40 million is available for neuroscience research at the participating institutions. A critical mass of both faculty and facilities exists at MUSC in the basic science of stroke and clinical applications. The Departments of Physiology and Neuroscience, Neurology, Neurosurgery have combined to form the Department of Neuroscience at MUSC. It is in the top 20% of Neuroscience Departments in NIH funding, and in the process of hiring 17 new faculty over the next three to five years.

- WEAKNESSES

Organization. It is difficult to ascertain from the proposal how the positions will be integrated with existing faculty, and the coordination of MUSC with USC is not well established. It is not clear to what extent the center would be "real" relative to "virtual," or how the translational research will be coordinated to link basic and clinical research efforts. There is a substantial risk of creating a poorly coordinated multi-institutional center, without adequate commitment at any of the participating institutions. Recruitments should target stroke-specific researchers more explicitly. Of the 17 neuroscience hires at MUSC, only 2-3 appear to be translational neuroscientists, and it is not clear that any would necessarily have stroke-specific interests. There is a need to coordinate senior and junior hires to expand connections to stroke-related programs. Leadership and administrative support of the center is vague in the proposal.

Economic Impact. It is highly speculative that the incidence of stroke and associated healthcare costs would be reduced as much as 50% over the next 5-10 years, especially when the focus is extensively on therapy. Even with such a major reduction, the cost savings is estimated at only $100 million. In addition, cost savings is not equivalent to economic development for South Carolina. Opportunities for pharmaceutical development could be significant, but not yet well established.

Institutional Investment. Only $125,000 income per year for each of the $2.5 million endowments would be available. Major supplementation will be needed, including equipment and start-up needs beyond the funds explicitly identified in the proposal.

National Status. The program is at a relatively early stage of development and does not rank on the Top Tier nationally as a center for stroke-related research. Recruitment will be essential, but highly challenging, given the paucity of experts nationally with strong expertise in stroke.

- RECOMMENDATION

It appears early for a CoEE investment at the level requested in the proposal. As a Tier 2 priority, some consideration could be given to a resubmission of the proposal focused on one position at MUSC. This would constitute an incremental step towards a more comprehensive effort in stroke-related research and clinical applications, and would provide additional leadership in elaborating a suitable vision and coordinated structure for the center.

Category 3- Not Recommended For Funding at This Time

The Review Panel did not assign a ranking to proposals in this category; the Team does not consider these proposals to be appropriate for funding in their current form.

CLEMSON – MOLECULAR GENETICS - $5,000,000

- DESCRIPTION

This proposal requests an Endowed Professorship of Human Genetics for the South Carolina Center of Economic Excellence in Genetics. The CoEE represents a collaboration between Clemson University and Greenwood Genetic Center; indeed, the proposed Chair in Human Genetics would be housed in a Clemson facility on the Greenwood campus. The objectives are to increase current strength in genetics at both Clemson and Greenwood, to create new technology-based industries that tap discoveries in human and plant genetics, and to educate and train the supporting workforce. The proposal requests $5M for the Endowed Professorship in Human Genetics and anticipates attracting an additional $5M in matching funds

- STRENGTHS

The proposal has significant strengths. Many of the required components for the CoEE are already in place, including the Coker Chair in Plant Molecular Genetics, Bioprocessing Facility and related Endowed Chair (to be recruited), the DNA Learning Center for outreach and education, the facilities and resources of the Clemson University Genetics Initiative, the important research in genetics of human disability at GGC, and the South Carolina Biotechnology Incubation Facility on the GGC campus. Clemson has demonstrated a strong recruiting record in the area of molecular genetics and biochemistry, having recruited 12 new faculty into the Department of Genetics and Biochemistry

since its establishment in 2001. The investment in faculty recruitment, facilities and resources is evidence of strong institutional commitment to the CoEE. Particularly impressive is the plant molecular genetics program which has substantial opportunity for economic development.

- WEAKNESSES

Human genetics and the genetics of human disease are highly competitive areas nationally and internationally, with strong and well-established academic leaders in cities that attract the lion's share of funding and industrial partnership. The panel is concerned as to whether the proposed investment would propel the Clemson/GGC partnership to a highly visible position in this competitive arena. Compelling evidence was lacking to indicate that the ongoing work in human genetics would be successful in attracting significant biotechnology industry to the area. In general, the biotech industry in the biomedical field is in its infancy in South Carolina. It was not clear that South Carolina will be competitive with other major, well-established sites of biotechnology in the field of human genetics.

The proposal does not indicate a planned collaboration with a medical school or academic health center. Such collaboration would be critical for the translation of health-related discovery. The collaborating institutions do not have the expertise or facilities for clinical research.

The proposal acknowledges that workforce training in human genetics is critical for developing the biotechnology industry. Only a few Ph.D. students have graduated from the Greenwood program, although this is the major training environment for human genetics for the CoEE. The commitment and capability to provide the required workforce is not clear.

Panel members expressed concern about the distance between the collaborating institutions. Placement of the Endowed Chair at GGC is likely to weaken the development of a Genetics CoEE that has significant components on the Clemson campus.

- RECOMMENDATION

While the proposal has many significant strengths, these are outweighed in the panel's view by the identified concerns. This proposal is not recommended for funding at this time.

MUSC - Molecular Nutrition: Molecular Physiology - $2,000,000

- See review for Research Center of Economic Excellence in Molecular Nutrition above.

USC - Molecular Nutrition: Molecular Kinesiology - $2,000,000

- See review for Research Center of Economic Excellence in Molecular Nutrition above.

USC - Materials Physics, Engineering, and Nanoscience Technology - $4,000,000

- DESCRIPTION

This proposal seeks to establish an endowed chair in Materials Physics, Engineering, and Nanoscience Technology.

- STRENGTHS

This is one of four technology clusters that the University of South Carolina has identified for further development. It would bolster existing strengths and bridge emerging nanoelectronics capabilities.

The commitment from the university is strong including excellent cost-match and infrastructure support. For example, the university has established an impressive new core facility for Electron Microscopy with a resolution of 0.08 nm, one of the best EM centers in a state university in the nation. The program in nanoscience will produce graduate students who will be competitive for jobs nationally and would potentially help to build a workforce in this area in South Carolina.

The university has identified a top candidate for this endowed chair with excellent credentials in materials science and a high national profile.

- WEAKNESSES

This proposal lacks a *clear application* where the research can be competitive with both other universities and with industry. The vision of the center is weak because it lacks a well-defined focus and is not particularly novel.

The external committee was not impressed with answers to questions regarding competition in core nanoelectronics technologies with such giant companies as Intel. For example, the proposers stated that USC would be pursuing "disruptive technologies" that would both dramatically advance the field and would not be addressed by industry. However, because traditional technologies have been nearly exhausted, industry is in fact pursuing just such novel new nanostructures for next generation advanced computer electronics.

The relationship between other nanotechnology initiatives at USC was not clearly articulated. As a result, we and the external reviewers have concerns about how this potential center would be organized, managed, and coordinated. For example, the laser lighting work appears to be somewhat force-fitted as opposed to a natural and necessary piece of the overall effort.

NSF funding has been flat at USC for the last several years, attributed to faculty seeking industrial funds rather than federal funds. But growth in federal funding for focus areas such as nanoscience is evidence of strength from which to build. The answer is both industrial and federal funding, not just one or the other.

Finally, it seems unlikely that any short-term technology spin-offs would emerge from the proposed center of excellence. Intellectual property, new jobs, and new companies are not likely in the near future.

- RECOMMENDATION

The review team does not recommend funding of this proposal.

USC/ MUSC/ Clemson - Center of Economic Excellence in Healthcare Quality - $5,000,000

- STRENGTHS

Area of National Need. The Center for Healthcare Quality (CHQ) strives to create a research organization that would help address the national healthcare crisis. The proposed CHQ would improve the quality and economics of South Carolina's healthcare system by:

1. Creating an electronic health portal,
2. Developing a clinical research organization,
3. Establishing a clinical research education unit.

These goals represent a significant opportunity for the HSSC to be a national leader in enhancing healthcare quality.

Collaborative Framework. A suitable framework for collaboration is envisioned for the integration of scientists, clinicians, and information systems for improved disease management, quality care, and patient safety.

Healthcare Portal. A portal that assimilates clinical data, claims history, and socioeconomic information would be an exceptional information resource.

Clinical Research Organization. The CRO would enhance clinical trials associated with HSSC institutions, especially complex multi-center trials.

Clinical Research Education Unit. The CREU would provide important assistance to researchers and facilitate the training of graduate students and post-doctoral fellows.

Office of Research Statistics. ORS is a unique resource in SC providing access to data from diverse state agencies and other entities. It is already a national model for data linkage and collaboration, especially in health services.

Alignment with NIH Roadmap. The CHQ would promote a multidisciplinary research continuum to facilitate the movement of ideas from the "lab bench to bedside to practice."

SC Light Rail Concept. There is an emergent concept for a high performance IT infrastructure essential for addressing CHQ objectives.

Financial Commitments. There is a strong base of financial support including individual HSSC institutions, the pending Duke Foundation grant, and prior CoEE investments in the HSSC programs. It appears that the CHQ will continue to move forward even in the absence of dedicated CoEE funding.

- WEAKNESSES

Limited Development of IT Infrastructure. In direct contrast to the strength of the vision for the CHQ concept, there is great uncertainty regarding the timescale and overall resource base for creating the IT infrastructure that is the foundation for the CHQ. South Carolina Light Rail is far from effective implementation. There are concerns that the DWDM (Dense Wave Division Multiplexing) associated with dark fiber utilization needs to be more aggressively pursued and made a higher priority. In addition, it is not clear how the ORS would be connected to the SC Light Rail. ORS currently is part of the State of SC Network and does not appear to be included in the framework of the proposed SC Light Rail.

Challenges Associated with Electronic Records. Many states have struggled to implement "interoperable" electronic health records. There are major concerns and on-going risks associated with confidentiality and security of information, as well as the myriad of hardware/software challenges impeding effective systems integration.

Inadequacy of Management Plan. The management and associated business plan for the CHQ are not well developed. It is not clear to what extent the proposed endowed professorships would or should be positioned to take on the development and management of the CHQ, including the Health Data Portal and the CRO.

Status of Industry Partnerships. Although opportunities for collaboration with industry partners are emerging, it is not clear that a key or "anchor" partner such as IBM is fully committed to the project.

- RECOMMENDATION

Although the importance of the project and the vision is well established for the CHQ, there remains great concern about the status of the IT infrastructure and associated business plan for implementing the Center. Accordingly, the proposal is given a Tier 3 status. However, the HSSC is encouraged to continue to develop the strategies and plans to create the CHQ, and needs to re-examine the use of the endowed chairs within the broader initiative.

SUMMARY OF RECOMMENDATIONS

Category One Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
Advanced Fiber-based Materials	1			$4,000,000
Molecular Proteomics/ Cardiovascular		2		$5,000,000
Solid Oxide Fuel Cells			1	$3,000,000
Childhood Neurotherapeutics		1	2 *	$6,000,000
Molecular Nutrition/ Nutrigenomics	1			$2,000,000
Total	2	3	2	$20,000,000

Note: * The Endowed Chair in Translational Therapeutics at Greenville Hospital will have an academic appointment at USC.

Part Five: Recommendations for Infrastructure

Advanced Broadband Networking

Last year's Review Panel made a specific and detailed recommendation that South Carolina move rapidly to follow the other states that are building very high bandwidth networks that use "dark fiber"—that is to say where the state secures direct access to the fiber and lights it with its own equipment. This approach allows for better scalability and lower costs than existing alternatives.

The Review Panel was very pleased to see information about the South Carolina Light Rail plan. This appears to be an appropriate response to the imperative of building the kind of network that will support increasing levels of collaboration. Members of the Review Panel offered some technical reactions to the plan (which need not be discussed here). One comment that might be of general interest, however, is the aspect of fostering community "rings" to provide an on-ramp to the statewide program. The existing plan, as we understand it, envisages the creation of these rings occurring in a later stage; experience in other states, however, suggests that it is possible to move more aggressively in this area. Ohio, for example, has lit 1,600 miles of fiber and has connected over a dozen of these local rings that support not only colleges and universities but also schools and university-affiliated hospitals.

Computational Science

The 2005 Review Panel also suggested that South Carolina consider an initiative in the rapidly growing field of computational science. As signaled in a recent National Science Foundation report, most scientific advances are now expected to depend on the ability of researchers to build highly complex computer models and simulations of things processes such as the interaction of drugs and cells at the molecular level. Colleges and universities will also need to invest in this field if they are to be effective in assisting business and industry. To illustrate, the automotive industry is avoiding the time-consuming and extremely expensive process of building mock-ups of new vehicles (called "mules" in the trade) by doing as much testing as possible using computer-based models.

NSF on the Value of Simulation and Modeling

"The practice of science and engineering at the research frontier has changed markedly in recent years, owing in large measure to the impact of increasingly powerful and pervasive information technology (IT). Today, simulation and modeling are as important to discovery and innovation as are theory and experimentation… These advances in IT are also revealing transformational opportunities to promote and advance learning, to expand and make use of discoveries in human cognition, and to enable distributed learning through enhanced access and peer-to-peer technologies."

NSF Cyberinfrastructure RFP
http://www.nsf.gov/pubs/2006/nsf06548/nsf06548.htm

The Review Panel heard evidence of wide-ranging activities in computational science, but did not find information to suggest that this is as yet a major area of collaboration. The hiring of Professor James Bottum, an eminent computational scientist as well as leader in advanced networking, as Chief Information Officer at Clemson may provide the foundation for new collaborative activities in this area.

Technology Transfer

Since economic impact is the ultimate goal of the Research Centers of Economic Excellence Program, it is crucial that the infrastructure for supporting technology transfer out of universities be in place as research grows on the three campuses. The Review Panel was pleased to learn that the South Carolina Research Authority has been instructed by the SC General Assembly to establish three Research Innovation Centers located close to each of the three research universities. It is appropriate that a goal of these centers is to "enhance the research and technology transition capabilities of the three universities."

Two additional critical components needed to support the commercialization of intellectual property out of the universities is pre-seed funding and venture funding. The latter appears to be underway with the Venture Capital Investment Act of South Carolina. However, pre-seed funding is probably far

more important to enable moving intellectual property out of the universities. It is often that in their early stage of development startup companies require small amounts of funding, $50K-$200K, to complete crucial tasks such as creation of a business plan or prototype development. The Review Panel urges the State to consider establishing a pool of funding to move ideas across the "valley of death."' A variety of approaches are being pursued in other states, for example Oregon's current implementation of State Senate Bill 853 passed in 2005. It provides a 60% state tax credit for private donations to universities enabling pre-seed funding for proof of concept activities and early stage funding for university-derived start-up companies.

It is very important that metrics for evaluating the success of transfer of research into commercial products be established. The Review Panel is well aware that it will take several years for viable commercialization of university intellectual property. However, standard measures (such as disclosures, patents filed, patents received, licenses issued, licensing income, start-ups) of technology transfer should be evaluated on a yearly basis and supplied by the three research Universities to the Review Panel prior to their site visit. The metrics used in the Association of University Technology Managers' (AUTM) annual licensing survey could be utilized for this purpose. Examination of these indices, especially when they are normalized to the level of research expenditures, should help in the analysis of the success of the Research Centers of Economic Excellence Program. Typical performance metrics for AUTM institutions are one disclosure per $2 million in research expenditures, one start-up created per $100 million in research expenditures, and 1-2% for the percentage of annual licensing revenues ratioed to research expenditures.

Graduate Education

The Review Panel was surprised by the relatively sparse mention of graduate education in the proposals. As mentioned earlier, graduate students are very much at the core of successful research-economic development strategies: it is widely accepted among business and higher education leaders that the best form of technology transfer is in the minds of graduates.

One idea that the three universities might consider would be to include marketing to prospective students the ability they will have to draw on faculty, instrumentation, and related resources from all three universities.

The universities might also consider the idea of true, multi-university graduate programs. This would be a big and challenging step, but one that would make sense in a fiercely competitive environment. Technology, in the form of broadband networking, is beginning to change the way people think of interacting across distance.

Part Six: Conclusion

The Review Panel believes that South Carolina has an exceptionally strong program in the Research Centers of Economic Excellence. The investments made in the currently recommended programs, together with additional funds provided in the future, will produce extraordinary benefit for South Carolina. Given the demonstrated impact of cluster effects stemming form the aggregation of innovative people and an entrepreneurial climate, the Review Panel recommends that the program be continued beyond 2010 and, if possible, expanded.

Appendix: Important Documents

South Carolina General Assembly

CHAPTER 75.
SOUTH CAROLINA RESEARCH CENTERS OF ECONOMIC EXCELLENCE

SECTION 2-75-05. Short title; legislative intent.

(A) This chapter is known and may be cited as the "South Carolina Research Centers of Economic Excellence Act".

(B) The General Assembly finds that:

(1) it is in the public interest to create incentives for the senior research universities of South Carolina consisting of Clemson University, the Medical University of South Carolina, and the University of South Carolina to raise capital from the private sector to fund endowments for professorships in research areas targeted to create well-paying jobs and enhanced economic opportunities for the people of South Carolina;

(2) these endowed professorships should be used to recruit and maintain leading scientists and engineers at the senior research universities of South Carolina for the purposes of developing and leveraging the research capabilities of the universities for the creation of well-paying jobs and enhanced economic opportunities in knowledge-based industries for all South Carolinians;

(3) in communities across the United States in which better paying jobs and enhanced economic development in knowledge-based industries has flourished, the local or state government has created incentives and made a long-term commitment to public and private funding for a significant number of endowments for professorships in targeted knowledge-based industries;

(4) the South Carolina Education Lottery provides a source of funding and an incentive for the senior research universities to raise, in dollar-for-dollar matching amounts, sums from private sources sufficient to create endowed professorships;

(5) these endowed professorships should be awarded to the senior research universities through a competitive application process, provided that the competitive process must encourage the senior research universities to submit cooperative applications with one another as well as in cooperation with other institutions of higher education; and

(6) these endowed professorships, funded equally from the South Carolina Education Lottery and from other private sources, provide a foundation for the creation of centers of economic excellence.

Section 2-75-10. There is created the Research Centers of Excellence Review Board. The board shall consist of nine members. Of the nine members, three must be appointed by the Governor, three must be appointed by the President Pro Tempore of the Senate, and three must be appointed by the Speaker of the House of Representatives. The terms of members are three years and members are eligible to be appointed for no more than two additional terms. Of the members initially appointed by the Governor, the President Pro Tempore, and the Speaker of the House, one shall be appointed for a term of one year, one for a term of two years, and one for a term of three years, the initial term of each member to be designated by the Governor, President Pro Tempore, and Speaker of the House when making the appointments. The Governor, the President Pro Tempore, and the Speaker of the House shall appoint persons with substantial experience in business, law, accounting, technology, manufacturing, engineering, or other professions and experience which provide an understanding of the purposes of this chapter. The board shall be responsible for providing annually to the Commission on Higher Education a schedule by which applications for funding are received and awarded on a competitive basis, the awarding of matching funds as provided in Section 2-75-60, and for oversight and operation of the fund created by Section 2-75-30. The review board must provide an annual report to the Budget and Control Board, which shall include an audit performed by an independent auditor.

Section 2-75-20. The presidents of the senior research universities shall serve as ex officio nonvoting members of the board.

Section 2-75-30. There is created the Centers of Excellence Matching Endowment. The endowment must be funded annually by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200,000,000 by 2010. The fund must be managed by the State Treasurer, subject to awards from the endowment as provided in this chapter. Interest earnings of the endowment must remain in the fund.

Section 2-75-40. The senior research universities, individually, in conjunction with one or more other senior research universities or with other South Carolina higher education institutions, may make application for awards from the endowment as provided in this chapter.

Section 2-75-50. An application for an award from the endowment shall:

(1) provide to the board documentation of private matching funds, on hand, in an amount equal to the amount for which application is made;

(2) provide to the board documentation that all matching funds have been committed and raised exclusively from sources other than South Carolina tax dollars, and that the funds have been committed and raised after January 1, 2002;

(3) be in an amount of not less than two million dollars and not more than five million dollars;

(4) document that the application has significant potential to provide for enhanced economic development for the citizens of South Carolina in a specified knowledge-based industry or field of commerce; and

(5) provide specific partnering activities with other institutions, businesses, or the community.

Section 2-75-60. Upon a determination by the board that the provisions of Section 2-75-50 have been met, the board must appoint a panel of experts chosen from outside South Carolina for their expertise in the respective research field to review the application. The members appointed to the panel shall have no affiliation with the senior research universities. The panel will convene in the State to review the proposals and to conduct site visits to ensure that appropriate research infrastructure exists at the applying university. The panel shall make a report and recommendation to the board as to the merits of the application not more than ninety days after submission to the panel. The board shall then make a determination as to whether or not to award the matching funds and the amount of the award.

Section 2-75-70. Staff and support for the operations of the board and the panels must be provided by the Commission on Higher Education. The Commission on Higher Education shall approve all necessary funds for the prudent operation of the board, including per diem, subsistence, and mileage expenses of board members as provided by law for members of state boards, committees, and commissions, and for the costs and expenses of the panel members. The expenditures authorized by this section must be provided from the fund created by Section 2-75-30 upon approval by the commission.

Section 2-75-80. If any section, subsection, paragraph, subparagraph, sentence, clause, phrase, or word of this chapter is for any reason held to be unconstitutional or invalid, such holding shall not affect the constitutionality or validity of the remaining portions of this section, the General Assembly hereby declaring that it would have passed this section, and each and every section, subsection, paragraph, subparagraph, sentence, clause, phrase, and word thereof, irrespective of the fact that any one or more other sections, subsections, paragraphs, subparagraphs, sentences, clauses, phrases, or words hereof may be declared to be unconstitutional, invalid, or otherwise ineffective."

Source: www.scstatehouse.net/code/t02c075.htm

South Carolina Research Centers of Economic Excellence
Summary of Purposes and Goals

During the 2002 legislative session, the South Carolina General Assembly passed the *South Carolina Research Centers of Economic Excellence Act*. With an allocation of $30 million in lottery funds, to be matched on a dollar-for-dollar basis with non-state funds, the General Assembly established a competitive grants program to award to South Carolina's three research universities funds endowed professorships in areas that will enhance economic opportunities for the state's citizens.

The Act created the *Centers of Excellence Matching Endowment*, which is to be funded annually by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200 million by 2010. Moreover, the Act established the *Research Centers of Excellence Review Board* consisting of twelve members; the Commission on Higher Education provides staff assistance to the Board. The *Board* is responsible for awarding state matching funds, for oversight and operation of the fund, and for various accountability requirements established in statute for the program.

The legislation establishing this program is very explicit as to its purpose:

> "It is in the public interest to create incentives for the senior research universities of South Carolina consisting of Clemson University, the Medical University of South Carolina, and the University of South Carolina to raise capital from the private sector to fund endowments for professorships in research areas targeted to create well-paying jobs and enhanced economic opportunities for the people of South Carolina."

The legislation goes on to say that the endowed professorships should be "used to recruit and maintain leading scientists and engineers at the senior research universities of South Carolina for the purposes of developing and leveraging the research capabilities of the universities for the creation of well-paying jobs and enhanced economic opportunities in knowledge-based industries for all South Carolinians."

Made explicit largely through its title is the intent of the program to create a critical mass of senior researchers around whom a Center of Excellence can be built. Such a Center will include other senior and junior faculty, graduate students, and public/private partnerships with business and industry. Through research and its eventual application, the clear expectation of the act is that job creation and other economic stimuli (e.g., patents, licenses) will result over time.

The legislation acknowledges the success of other communities in creating economic opportunity through knowledge-based industries by providing through their state or local governments incentives and a long-term

commitment to public and private funding for "a significant number of endowments for professorships in targeted knowledge-based industries." Thus, the program's stated intent is to provide $30 million from lottery funds, to be matched by the institutions on a dollar for dollar basis by "private" funds, each year through the year 2010.

The legislation stipulates that awards are to be made through a competitive application process which encourages collaboration among the three research institutions as well as cooperation with other higher education institutions. Funding decisions are to be made by a nine member Research Centers of Excellence Review Board, three members of which are appointed by the Governor, the President Pro Tem of the Senate, and the Speaker of the House respectively.

Source: http://www.endowedchairs.org/Program_purposes_and_goals.pdf

South Carolina Research Authority (SCRA)

At SCRA and our affiliated institutes, we develop technology solutions to meet the complex needs of customers in government and business.

To do that, we assemble multi-organization teams that can include governmental groups, universities, major corporations, technology companies, consultants and our own staff of specialists in disciplines ranging from computer science to advanced metallurgy.

Working with these collaborative teams, we identify applicable technologies and use innovative strategies to adapt them to client needs. In addition, our projects often make use of SCRA capabilities to ensure that customers are able to implement and use the new technologies effectively.

In our 21 years of operation, SCRA and our affiliated institutes have emerged as international leaders in this unique field of consortium management, attracting more than $68 million in annual revenue. Current customers include groups within the Department of Defense, Department of Justice, Department of Transportation, Department of Energy, and Department of Commerce as well as private industry, medical centers, state and regional transportation departments, and security/law enforcement agencies.

SCRA also works to enhance research infrastructure within South Carolina. We support the efforts of faculty at state academic centers to secure project grants and build new capabilities, and we manage a system of research parks that attracts technology companies. These parks are now home to 40 technology-oriented firms employing nearly 6,000 people.

Source: www.scra.org

Information on the Centers of Innovation can be found at
http://www.scstatehouse.net/sess116_2005-2006/bills/3794.htm

Health Sciences South Carolina

Health Sciences South Carolina is a public-private collaborative partnership between two of South Carolina's leading universities, the Medical University of South Carolina (MUSC) and the University of South Carolina (USC), and the state's largest health systems, Palmetto Health and Greenville Hospital System.

The mission of Health Sciences South Carolina is to advance health sciences research, education, and public health in the Palmetto State. Each of the four partners has agreed to invest $2 million per year for 10 years in health sciences research, an investment of $80 million. Matching dollars from the South Carolina General Assembly through the Life Sciences Act raise the total investment to $160 million.

Since the collaboration was formed in April 2004, GHS has made a series of announcements made possible in part by Health Sciences South Carolina. Click the link below for press releases related to this historic initiative.

Source: http://147.202.35.75/hospital/10057/

South Carolina
Research Centers of Economic Excellence
Review Panel Report

May 31, 2007

In May 2007 a Review Panel of seven consultants convened in South Carolina to review and assess the merits of Endowed Professorship proposals submitted to the South Carolina Research Centers of Economic Excellence Review Board during the 2006-07 funding cycle.

This document presents the findings and recommendations of the Review Panel and is organized as follows: Part One provides an overview of the Endowed Chairs program; Part Two provides general findings and recommendations from the Review Panel; Part Three offers suggestions on improving program operation. Part Four describes the Panel's recommendations for funding based on their review of the 2006-07 proposals; Part Five provides Panel recommendations for the development of infrastructure supportive of the Endowed Chairs program; and Part Six offers a summary conclusion from the Panel.

Part One: Program Overview

Program Description and History. During the 2002 legislative session, the South Carolina General Assembly passed the *South Carolina Research Centers of Economic Excellence Act*. With an annual allocation of up to $30 million in lottery funds, to be matched on a dollar-for-dollar basis with non-state funds, this competitive grants program awards to South Carolina's three research universities funds to establish Endowed Professorships in areas that will enhance economic opportunities for the state's citizens. The program is funded by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200 million by 2010.

Awards are made through a competitive application process which encourages collaboration among the three research institutions and with other higher education institutions in the state. Funding decisions are made by a nine-member Research Centers of Excellence Review Board, three members of which are appointed by the Governor, the President Pro Tempore of the Senate, and the Speaker of the House respectively.

Current Program Status. The program is currently in its fifth year of soliciting and reviewing proposals from the state's three research universities. The 2006-07 funding cycle initially includes 7 proposals.

Over the last four years the Review Board has approved funding for 30 research proposals from USC, MUSC, and Clemson University and their partner-institutions, totaling $122 million in state lottery funds. To date over $52.4 million in lottery funds have been drawn down and distributed to the institutions, and the institutions report over $91.8 million in matching fund pledges, of which over $63 million have been received.

The 30 Board-approved Research Centers represent a diverse palate of research fields: Automotive Research and Vehicle Electronic Systems (associated with the International Center for Automotive Research, or ICAR), Supply Chain Optimization and Logistics, Molecular Nutrition, and Historical Restoration at Clemson University; Nanotechnology, Hydrogen Storage and Hydrogen Fuel Cell Sensors, Solid Oxide Fuel Cells, and Travel and Tourism Technology at the University of South Carolina – Columbia; and Proteomics (protein research), Marine Genomics (genetic research), Brain Imaging, Regenerative Medicine, Vision Science, Neuroscience, Clinical Effectiveness and Patient Safety, Molecular Proteomics, and Cancer Drug Discovery research at MUSC. Partner institutions for several Centers include the College of Charleston and Coastal Carolina University, as well as statewide organizations such as Health Sciences South Carolina. A number of Centers also represent collaborative efforts among the state's three research universities.

The program is currently in its fifth year. The 2006-07 funding cycle included 7 individual and collaborative proposals:

Institution(s)	Project Title	Amount Requested	Chairs
USC	Rehabilitation and Reconstructive Sciences	$5 Million	1
Clemson/MUSC/USC	Health Facilities Design and Testing	$5 million	2
USC	Strategic Environmental Approaches to Electricity Production from Coal	$5 Million	1
MUSC	Tobacco Related Malignancy	$5 Million	2
MUSC/USC	Stroke	$5 Million	3
USC/Clemson	Promoting Older Adult Independence	$5 Million	3
Clemson	Human Genetics	$2 Million	1
	7 Proposals	**$ 32 million**	
	Available 2006-07 funding	**$28 million**	

Evaluating the Proposals. The process of assessing the quality and viability of each proposal proceeded in two phases. The first phase involved submitting the proposals via e-mail to external reviewers to determine the technical and scientific merit of each research project. The goal of this process was to obtain a minimum of three technical reviews: two from reviewers recommended by the institution submitting the proposal, and one from acknowledged experts in the field who have not been recommended by the submitting institution. Reviewers were asked to assign points to the proposal in each of four categories: Scientific and Technical Merit (up to 40 points); Approach, Process, and Execution (up to 25 points); Innovation (up to 25 points); and Infrastructure, Support, and Collaboration (up to 10 points). The maximum point total is 100.

The second phase of review involved assembling a team of consultants ("Review Panel") to visit the campuses, attend formal presentations by the Principal Investigators submitting the proposals, and meet with institutional leaders. Prior to their arrival in South Carolina, the Review Panel received and reviewed the proposals in their entirety, as well as the phase one technical and scientific reviews. Although the Review Panel carefully weighed the technical merits of each proposal to determine base line quality and competitiveness, the primary focus of their subsequent assessment was upon the degree to which each proposal was consonant with institutional mission and the potential economic contribution of each project to the state of South Carolina.

Further, each proposal was assigned a lead reviewer and a secondary reviewer. The role of the lead reviewer was threefold: 1) to serve as the effective chair of the Panel for that proposal, including taking the lead in formulating questions; 2) leading the Panel's internal discussion and ranking of the proposal during deliberations; and 3) drafting the narrative section required for the final report. The second reviewer provided reinforcement and support for the lead reviewer assigned to each proposal.

At the conclusion of each day's campus visits the Review Panel convened to discuss the proposals and begin drafting a preliminary report. During subsequent weeks the Panel, under the guidance and direction of Panel Chair Walters, communicated via telephone and e-mail to arrive at final conclusions and funding recommendations. The 2006-07 Review Panel included seven returning consultants:

Name	**Title**	**Institution**
Jack Burns, Ph.D.	Vice President Emeritus for Academic Affairs & Research	University of Colorado
Laura S. Levy, Ph.D.	Associate Senior Vice President for Research	Tulane University
Richard Linton, Ph.D.	Vice President for Research & Graduate Studies	University of Oregon
James Roberts, Ph.D.	Vice Provost for Research	University of Kansas
Charles O. Rutledge, Ph.D.	Vice President for Research	Purdue University
Tony Waldrop, Ph.D.	Vice Chancellor for Research	UNC – Chapel Hill
Garrison Walters, Ph.D. (Chair)	Senor Vice Chancellor for Academic Affairs and Economic Advancement	Ohio Board of Regents

Part Two: General Findings and Recommendations

The Research Centers of Economic Excellence 2007 Site Review Panel conducted a visit to Charleston (MUSC), Columbia (USC), and Clemson (Clemson), on May 7-9, 2007. Thanks to the excellent work of the staff of the South Carolina Commission on Higher Education, the participating universities, and the many collaborating organizations, the visit was very well-organized and highly informative. Taken together with the extensive documentation provided in advance, the Review Panel believes that it had access to sufficient information to make recommendations for funding. Those recommendations are provided in detail in Part Four of this report.

The extensive documentation on the Research Centers program, together with the opportunity to interact with university personnel and representatives of affiliated organizations, also provided the Review Panel with an opportunity to comment on the overall purpose, structure, and foundations of the program.

S.C. Research Centers of Economic Excellence is One of the Nation's Best Programs

The Review Panel again applauds the state of South Carolina for its vision in developing and implementing the Research Centers of Economic Excellence Program. As the United States moves into what the writer Thomas Friedman calls a "flat world," where knowledge is the principal currency, a state cannot make a better investment than in its research institutions. South Carolina has constructed a program that focuses state resources on strategic goals, exploits natural advantages, and leverages private funds. Importantly, the process is well organized and relies on external reviewers to recommend particular proposals for funding.

Talent attracts

When semiconductor giant Intel announced a few years back that it was going to add a new R&D facility in Austin, a reporter asked Albert Yu, then head of Research for Intel, if the location was chosen to be near customers such as Dell Computer. Yu replied that Intel didn't need to be near its customers, and stated that the decision was made because "Austin has become a high-tech center, and we wanted to be near the University of Texas and the talent coming out of there."

EE Times, 9/24/98

Investing in people on the leading edge of knowledge is by far the best economic development strategy a state can have.

A simple illustration of the value of knowledgeable people can be found in the example of Google, the multi-billion dollar search engine company.

Google was founded in 1996 by two Stanford University computer science doctoral students. Sergei Brin (who came from Russia via Maryland) and Larry Page (from Michigan) were attracted to Stanford by its top quality computer science program, and once in Palo Alto found themselves in a cauldron of ideas and innovation fueled by the university's array of world-class science and engineering programs.

The idea of an Internet search engine was directly assisted by Stanford,[1] and Google became a privately held company in 1998. By 2005, its revenue exceeded $7 billion per year.

Google is a true Internet company and its headquarters could be located any place in the world that has decent telecommunications resources (Google's estimated 100,000 plus servers are spread across the globe). Given this mobility, one has to ask why the company remained in an area with an extremely high cost of living, serious traffic congestion, and very high taxes?

The answer is simple—Google is a company that depends on innovation[2] and it knows that the San Francisco Bay area is a hotbed of talent. The same factors that brought its two founders to the region keep the company there.

A similar example can be found in the advanced electronics sector. Stanford and UC-Berkeley are like giant vacuum cleaners, pulling in the best and brightest undergraduate and graduate students from all over the world. As a result, the Bay Area is sprinkled with large R&D facilities operated by semiconductor companies whose headquarters and manufacturing facilities are elsewhere—IBM's Almaden Research Center is one example. Again, the reason these high wage operations are where they are is to be close to the two universities' outstanding graduates. Simply put, talent attracts.

As noted in last year's report, South Carolina's superb strategy of investing in carefully focused clusters of talented people should begin to bear fruit quickly.

In the short-term (one to three years after activities begin) the program should increase the state's flow of federal and industrial research. This is a very considerable economic benefit to South Carolina: according to the Association of American Universities, every $1 million in total research expenditures supports 36.5 high-value, high-wage R&D jobs.[3] The use of the available interest monies for post-docs and graduate students (see Part Five, below), could sharply accelerate this process.

For the medium term (three to seven years), many of the proposals envision the creation of start-up companies. This will certainly happen to some extent, though the Review Panel emphasizes that this is an uncertain measure of success, dependent on an array of variables. In many fields, a more likely outcome in the medium-term is the attraction and expansion of existing companies. As the Intel example demonstrates (see sidebar above), outstanding research centers are a powerful magnet for technology companies.

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[1] Much is made, and appropriately so, of Stanford's support for entrepreneurs. It shouldn't be forgotten, though, that a necessary precursor for this is the university's standing as a center of knowledge creation. Stanford's total research of over $603 million in 2003 ranked it eighth in the country. Total academic R&D for South Carolina in 2002 was about $400 million.

[2] Google's famous policy of encouraging engineers to spend twenty-percent of their time on innovation is reported to be the source of many of their new products and services.

[3] Derived from data at: http://www.aau.edu/resuniv/FY97Employ.html.

In the long term, the Research Centers of Economic Excellence Program, if sustained and complemented with other investments in education, should strengthen the perception of South Carolina as a place with an active role in the knowledge economy. This, in turn, will attract educated people to the state—including in areas not directly connected with the Research Centers—and also encourage more, and especially more of the best, graduates to stay.

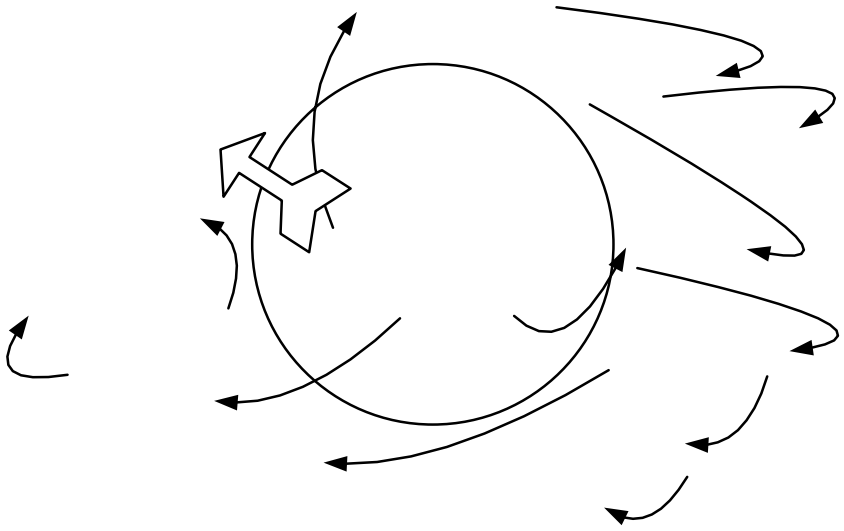
This investment in educated people is similar to the North Carolina model begun more than forty years ago. The other Carolina's success will not be easy to emulate. Progress will not be linear or fast. But the alternative, not trying to compete in the knowledge economy, is unacceptable.

In summary, the Research Centers of Economic Excellence is an exceptionally well-conceived program. The investments will have significant short and medium term benefits, and will help create a "buzz" about the state, that sense of being on the leading edge that makes bright people want to stay and others want to come. The Review Panel believes the program should be continued past the 2010 deadline and, if possible, expanded before then.

Additional Key Factors in South Carolina's Path to Success

Strong Universities

The 2007 Review Panel concurs with the Review Panels from prior years' visits on the quality of South Carolina's research institutions. The state has reason to be proud of their accomplishments, and the Review Panel wishes to emphasize some of the university successes that are especially important to the Research Centers program.



Leadership

Implementing complex plans requires sophisticated guidance, and the Review Panel believes that South Carolina's research universities have excellent leadership overall, very definitely in the areas of research and economic development. Members of the Review Panel who have participated since the first years are particularly struck by the ability of these leaders to design and implement strong strategic planning processes—our view is that South Carolina really stands out in this critical area.

Strategic Planning

As noted in last year's report, virtually every organization today employs some form of strategic planning, and the attendant processes have produced many fine words. Unfortunately, implementation in the real world is often lacking.

But strategic planning is an area where South Carolina stands out. The three universities have clearly gone beyond rhetoric and are implementing specific plans and making real, tangible progress. The universities began their planning at different times and as a result are not all at the same level of implementation, but the Review Panel believes that all plans have the potential to be highly successful.

A central element of the strategic planning at the three South Carolina universities is focus—putting a disproportionate share of resources on a few key areas where the university has a chance to excel. In today's complex research environment, where scale is an increasingly important factor in achieving the critical mass of talent, facilities, and equipment, focus of this kind is essential for all but a handful of the largest and most comprehensive institutions.

A key point about the universities' decisions on where to focus is that strengthening the economic development of South Carolina, while also improving the quality of life for its citizens, has been the driving criterion.

Institutional focus does carry some risk. Isolated programs can have difficulty securing the resources needed to be competitive. Also, shifting the necessary funds at a small or even a medium-sized institution can create a burden for other programs and threaten the university's ability to offer the needed array of undergraduate degrees. Multi-institutional collaboration is an effective vehicle for offsetting these problems, and, as discussed in the next section, the Review Panel believes that this is another significant South Carolina strength that is anchored in the Research Centers of Economic Excellence Program. Indeed, the universities have come far enough that the Review Panel continues to believe it might make sense for them to undertake a joint strategic planning effort in the area of research/graduate education (although, as noted in Part Five, the Panel continues to be disappointed in the attention given to graduate education in the proposals).

Collaboration

The Review Panel was very impressed with the level of collaboration among South Carolina's three research universities. As with the institutional strategic planning, there is a high level of substantive activity that transcends the rhetoric typically encountered in most parts of the country. Team members who have been present in earlier rounds note that there has been considerable progress in this area.

Particularly praiseworthy are the decisions to create a joint school of pharmacy between USC and MUSC and the creation of the Health Sciences South Carolina concept.[4] These are major undertakings that will require extensive administrative energy and—not to be overlooked—patience. Major initiatives of this kind, taken together with the array of activities in other areas of life sciences, travel/tourism, and more, suggest that the initials "SC" could stand for "Spirit of Collaboration" as well as South Carolina.

The Review Panel is pleased that there is progress in advanced networking, something that could be described as the circulation system of the collaborative corpus. Part Five offers some comments and suggestions on the process.

Part Three: Suggestions on Improving Program Operation

The Review Panel has been very impressed with the structure and operation of the Research Centers of Economic Excellence Program, and has been pleased that the process and proposal quality has continued to improve. In particular, this year's process showed evidence of effective response to previous suggestions: providing greater clarity of program vision; limiting the role of the endowed chair in program administration; and in clearly delineating the track record as well as the future of collaborations.

The Review Panel continues to have ideas about how the Research Centers program could be improved, however, and has provided the following thoughts on a variety of topics. Some of the topics are new, while one (Commercialization/Technology Transfer) has been moved to this section because the Review Panel believes changes are important for the proposal process (Part V covers more general recommendations for strengthening South Carolina's research and graduate education infrastructure).

Up-Front Funding

- While the endowment funds awarded through the Research Centers of Economic Excellence Program represent a critical building block for knowledge-based economic growth, the fact is, recruitment of world-class faculty to assume the Chairs is expensive and requires direct cost investment. Recruitment costs include salaries for junior faculty, postdoctoral trainees, students and staff who will accompany the Endowed Chair to South Carolina, specialized equipment and laboratory renovation. The direct cost investment for each recruitment might reasonably reach $2 Million - $3 Million to be expended over a period of 1 - 3 years. We recommend that the state consider mechanisms to provide assistance with the direct costs needs in support of faculty recruited to endowed chairs.

[4] A brief description is included in the Appendix.

Role of Basic Sciences

- The Review Panel has observed that the current proposals are heavily oriented toward the applied sciences—notably engineering, and translational biomedicine. This emphasis is entirely consistent with the purpose of the program, but the Panel is concerned that there needs to be greater inclusion of and support for the basic science areas that gird applications. In the long run, investing in "directed basic research" in chemistry, physics, and the core life sciences will be essential for advancement in applications. The Panel believes that university administrators developing programs should consider ways to provide incentives for basic science faculty to participate in Research Center proposals and also work with them and with department administrators to understand that taking part in applied activities is important (see the section on promotion and tenure, below).

Promotion and Tenure

- The research universities in South Carolina should be encouraged to develop policies and procedures that reward success in technology transfer in the academic promotion and tenure process. Clearly, not all faculty should be expected to be involved in entrepreneurial activities. However, consideration should be given to those who do participate. Traditionally, the promotion and tenure process awards academic measures of success including peer-reviewed publication and sponsored research awards; however, such measures of technology transfer as patent applications, licensing agreements and patent impact are frequently not considered. While the Review Panel strongly supports the use of traditional academic metrics for promotion and tenure at South Carolina's research universities, acknowledgement of success in technology transfer activities should be considered as well if it is an explicit objective of the state for its academic institutions.

  Another area for consideration by the promotion and tenure committee is for acknowledgement of participation in multidisciplinary teams. Many universities are now using this as one criteria considered in evaluation. Again, this should not be required of all faculty but considered for those who have significant impact as part of a team of researchers.

Commercialization Technology Transfer

Since economic impact is the ultimate goal of the Research Centers of Economic Excellence Program, it is crucial that the infrastructure for supporting technology transfer out of universities continues to mature as research grows on the three campuses.

Two critical components needed to support the commercialization of intellectual property derived from the universities are seed funding and venture funding. The latter is well underway with the Venture Capital Investment Act of South Carolina. Pre-seed and seed stage funding also are critical to enable moving intellectual property out of the universities. In their earliest stages of development, startup companies often require relatively small amounts of funding, $50K-$200K, to complete crucial tasks such as the creation of a business plan or prototype development. Last year, the Review Panel urged South Carolina to consider a specific pool of funding to move ideas across the "valley of death," including the possible creation of innovation funds supported by private investment and tax credit incentives being implemented in other states.

It is impressive to see the major progress in the seed funding arena since last year's report, specifically in the further development of SC Launch! SC Launch!, as a non-profit 501(c)(3) organization, accelerates entrepreneurial growth for advanced technology startups by delivering seed-funding of up to $200,000 in loans or investments, ongoing mentoring and business counseling, as well as access to Resource Network Services. Through the Resource Network, SC Launch! teams with business professionals and organizations to provide advice, mentoring, and services to SC Launch! clients.

The collaboration between SCRA, a technology R&D program management company, and South Carolina's research universities is key to the future success of SC Launch!. The initial funding for SC Launch! was $12 million from SCRA's cash reserves. To provide a source for ongoing funding support, the Industry Partner Act was passed in June 2006. The Industry Partner Act allows individual or corporate SC Launch! donors to take a South Carolina tax credit against income taxes, insurance premium taxes and certain license fees for 100% of the amount of the contribution.

As the infrastructure facilitating commercialized research continues to evolve in South Carolina, the Review Panel suggests that it is very timely to review several policy aspects of critical importance to effective technology transfer and intellectual property management, as follows.

- Considering the extent of collaborative engagement in the emerging CoEE programs, it is especially critical to make sure that multi-institutional concerns are addressed with respect to ownership, rights, sharing, stacking, or bundling of IP to optimize the technology transfer process and to enhance societal applications and impact.

- Management of both individual conflict of commitment and financial conflict of interest (CoI) is of growing concern nationally. For example, the Senior Research Officers of the AAU institutions recently indicated these issues as among the primary concerns facing the nation's premier research universities. In light of South Carolina's major investment in endowed chairs who are expected to catalyze translational research at the public/private interface, it is imperative to have effective policies in place to protect such faculty investigators, from the initial disclosures of potential conflicts, to the creation of effective management plans to address them. Additional concerns relate to the management of potential conflicts for individuals serving on executive or advisory boards for the various economic centers of excellence and associated initiatives.

- Because of the growing ties between the universities and the private sector, it is also important to develop and implement policies related to institutional conflicts of interest. Policy on institutional holding and management of equity stakes in university-derived spin-offs is a related item that deserves careful scrutiny. It was apparent to members of the Review Panel that additional work is needed on both individual and institutional CoI policies and implementation in South Carolina.

In light of the above examples, the Review Panel recommends that a workshop/retreat be organized with the various university stakeholders to address the status of IP and CoI policy needs and concerns, and to consider collaborative strategies for policy development to spark South Carolina's economic development while assuring the responsible conduct of research.

As noted in the Review Panel's 2006 report, it is very important that metrics for evaluating the success of transfer of research into commercial products be established. The Review Panel is well aware that it typically takes five years or more for successful commercialization of university intellectual property. In response to the recommendations of 2006, the Review Panel was delighted to see the universities presenting standard measures (such as invention disclosures, patents filed, patents received, licenses issued, licensing income, start-ups) of technology transfer. Such metrics should continue to be evaluated on a yearly basis and supplied by the three research universities to the Review Panel prior to the site visit, including those used in the Association of University Technology Managers' (AUTM) annual licensing survey. Examination of these indices, especially when they are normalized to the level of research expenditures, will continue to help in the analysis of the success of the Research Centers of Economic Excellence Program. The CoEE programs also are encouraged to think creatively and to examine best practices in other states to better capture the broader societal impacts of the targeted state investments.

Statewide Strategy

- As noted elsewhere, the participating universities have done a superb job of working together and building coherent strategies for the benefit of the state. Given this, it might be useful to illustrate the extent of current and planned synergy by producing a statewide version of the jigsaw puzzle metaphor used by USC to show how its program areas connect. Such an illustration would provide policymakers at the university and state levels with a useful perspective on overall strategy and collaboration. The Panel wants to emphasize, however, that this approach shouldn't have to mean that every new piece must fit neatly into the existing matrix—it will be important to leave room for innovation.

Reporting on Program Success

- The Research Centers of Economic Excellence Program is now at a point where the track record is relevant. Next year's Review Panel should have evidence from each university on the status of previously awarded chairs, included data on grants, technology transfer, etc. It will be reasonable to say that some programs are too new for extensive data, but each should have a report.

Part Four: Recommendations for Funding

The Review Panel has provided three general rankings for the proposals it reviewed:

Category 1, for immediate funding.

The Review Panel believes that programs listed here are already of high quality, have clearly defined goals and objectives, have most of the key resources for success in place and, if awarded one or more endowed chairs, should find the needed match reasonably quickly and move quickly to greater success. Proposals in this category are *not* ordered by rank.

Category 2, meritorious, but with one or more significant failings that could be remedied. Resubmission is encouraged, but should require a new proposal and some further external review by experts in the field.

These proposals are similar to those in Category 1 in many ways but require at least one significant change prior to being funded. The Review Panel has tried to state clearly the change or changes that are needed, but does not believe that funding should be provided without further external review to determine whether the problems have been resolved. Proposals in this category *are* ordered by rank.

Category 3, having serious or structural flaws. Resubmission is not encouraged without important re-conceptualization and clarification that would be equivalent to a new proposal.

The Review Panel believes that these proposals require substantial rethinking and would not recommend funding even if revised. Instead, new proposals could be advanced in the next competition. Proposals in this category are *not* ordered by rank.

Recommendations on the Individual Proposals

CATEGORY 1 – REQUESTED AND RECOMMENDED FOR IMMEDIATE FUNDING- (TOTAL AMOUNT $25,000,000)

The Review Panel did not assign a ranking to proposals within this category.

University of South Carolina/ Reconstructive Methodologies and Materials $5,000,000 Requested and Recommended

- **Description**

This proposal requests funding for an endowed professorship in Reconstructive Methodologies and Materials as the foundation for a Research Center of Economic Excellence in Rehabilitation and Reconstructive Sciences.

- **Strengths**

The proposers have assembled an extraordinary team of collaborators and partners to pursue a novel academic and industry affiliation for research in an area affecting many sports-active Americans and older adults. Together, they will investigate the biologics of tissue-engineered materials and implantable devices to find solutions to a variety of orthopedic maladies affecting thousands of people each year. The research and clinical activities will focus on novel materials to optimize rehabilitation and reconstruction of damaged joints and other orthopedic injuries. Both the research and the partnership are unique and well suited to emerging university and private sector expertise in this area.

The partnership between USC, Smith & Nephew, and Steadman-Hawkins is most impressive. Smith & Nephew has pledged $5 million to cost match funding from the South Carolina Lottery program. They are an international company (operating in 31 countries) with expertise in orthopedic reconstruction, trauma and therapies, endoscopy, and advanced wound management. Steadman-Hawkins brings unique clinical experience in this field along with a $300 million investment in hospitals and clinics throughout South Carolina. USC has a nationally prominent Exercise Science program, a bioengineering program, and emerging clinical programs in the Medical School. This combination makes for a strong team.

The endowed chair will be responsible for integrating the components of this collaboration and will lead the effort in developing a cutting edge program. The Endowed Chair will likely pursue the critical missing piece in this area, namely tissue engineering, along with cell harvesting, preservation, and bioreactors to advance successful orthopedic reconstruction and rehabilitation. The external review committee was told by the partners that they were attracted to South Carolina because of the strengths of USC and the Centers of Economic Excellence Program.

The economic development potential looks excellent. In today's marketplace, biological materials have a worldwide value of $1.7 billion. The P.I., Dr. Matthews, is a successful entrepreneur having produced a new start-up company, Carbonix, during the past year. His experiences, along with those of the partners, promise to yield significant economic impact in South Carolina in this medical field.

The external review committee was pleased to learn that USC, Smith & Nephew, and Steadman-Hawkins have already developed agreements on intellectual property that may emerge from this collaboration. In particular, USC will maintain ownership of the IP with the partners having first right of refusal to license the technology. This strikes the committee as an equitable arrangement which will encourage further public-private partnerships of this nature in South Carolina. The committee encourages USC to be vigilant in its oversight and management of potential conflicts of interest and the licensing of emerging technology from this Center.

- **Weaknesses**

The external review committee is somewhat unclear about the potential for further academic partnerships with other research universities outside of South Carolina in this emerging research area. The Committee felt that exploring partnerships with other strong universities nationwide would further boost the credibility and accelerate the research and clinical applications for USC.

The reviewers and the External Review Committee would like to have seen a bit more specificity on core projects in cellular engineering.

The Education Core, especially with regard to involvement of graduate students and the training of clinical researchers, was unclear.

- **Recommendation**

The external review committee recommends full funding ($5,000,000) for this proposal.

Clemson/MUSC- Center for Health Facilities Design and Testing
$5,000,000 Requested and Recommended

- **Description**

The proposed Center for Health Facilities Design and Testing, sponsored by Health Sciences South Carolina, would foster interdisciplinary applied research addressing relationships between health, healthcare and healthcare setting. The proposal requests funding for two endowed chairs: a Clemson-based chair in healthcare architecture, and a MUSC-based chair in human factors research in clinical practice.

- **Strengths**

This is an exceptional opportunity for South Carolina to become a national leader in the design of improved healthcare environments through the interdisciplinary development and testing of prototypes and associated medical technologies. The research agenda is well positioned to address four critical topics involving relationships between the built environment and:

- health and clinical outcomes
- patient, family and staff satisfaction
- operational efficiencies
- the ability to accommodate change

There clearly is a major market "pull" for the center's focus, with more than $40 Billion of current healthcare facilities construction nationally. The center would be well positioned to lead the trend toward "evidence-based design," including the drive to improve patient safety, the merging of diagnostic and treatment modalities, the incorporation of information technologies, and the adoption of new technologies for minimally invasive surgery.

Research on the built environment relevant to healthcare is still in a relatively early stage, generally not translational, and often reflects outdated designs. The proposed center would have the distinct advantage of providing new, rigorous and replicable models/methods with a focus on facilities platforms for innovative product development and testing.

One of the most compelling features of the Center for Health Facilities Design and Testing is the integration of teaching, research, development, and practice. There is great promise for design-build-test-refine approaches to provide for the timely fabrication and evaluation of health facilities prototypes. Professional and doctoral students would have diverse opportunities to participate in experiential learning related to the center's programs and projects. The proposed prototype facilities, one at MUSC in Charleston and one at the Spartanburg Regional Healthcare System (SRHS) Upstate lab, would

heavily leverage existing infrastructure and staff and should be sustainable through evolving public-private partnerships including healthcare providers.

The proposal highlights the diverse opportunities for incorporating federal and foundation sponsors, healthcare providers, the design community, and product manufacturers in the mission and activities of the center. Support for the center under the umbrella of HSSC is very strong, with the $5 Million match to be provided by SRHS ($2 million), and with Clemson and MUSC raising an additional $2 million and $1 million respectively. Berchtold Corporation, a global company based in South Carolina, is an impressive industry "anchor" for the center, and has pledged to support the initiative through direct funding, in-kind assistance on prototyping projects, and the formation of a consortium of surgical equipment and systems manufacturers relevant to the center's mission.

There are demonstrable opportunities for enhanced economic development spanning the cycle of innovation, from increased sponsored research to product design, testing, manufacturing and distribution. The start-up model for the center bears similarities to ICAR, although this proposal is on a more modest scale.

- **Weaknesses**

Concerns and questions raised by reviewers in advance of the site visit focused on a number of perceived limitations of the proposal, most notably:

- There was little discussion of research projects that would demonstrate specific approaches addressing the center's objectives.
- There were concerns about the ability to isolate the specific effects of the built environment on clinical outcomes in an experimental design involving prototype development and testing.
- There were questions about limiting the design research to "geographically focused" aspects, as opposed to macro-scale issues of overall health facility design.

The presentations during the site visit were especially effective in addressing the above concerns. Patient room prototypes were presented illustrating the approaches to simulation/evaluation/translational research and their linkages to clinical outcomes. The emphasis on "geographically isolated" sites, particularly spaces involving direct patient care, seems appropriate as a necessary precursor to studies related to facilities integration. The presentations also confirmed that the required expertise will be in place to develop evidence-based approaches and data evaluation protocols critical to establishing the direct impacts of the built environment on healthcare.

There remain some weaknesses in the proposal related to technology transfer and the commercialization of the research findings. It would be useful to develop outcome measures that would track the specific impacts of projects on patient health, health outcomes, and efficiencies of patient care. The proposal lacks substantive information on the infrastructure needed to move successful prototypes into the marketplace. There is little discussion of approaches surrounding intellectual property, especially when it is developed through complex collaborations and partnerships. There is no mention of policies and procedures to assure effective management of potential conflicts of interest, such as those that would face the CoEE endowed chairs who are charged to work at the intersection of public and private interests.

- **Recommendation**

The external review committee recommends full funding ($5,000,000) for this proposal. Because of budget constraints, the removal of the request for a USC endowed chair in the revised proposal has compromised some aspects related to public health engineering, novel materials, and systems expertise. The committee encourages the submission of a supplemental request in the next proposal cycle to address residual needs for additional endowed chair(s).

USC – Center of Economic Excellence in Strategic Environmental Approaches to Electricity Production from Coal
$5,000,000 Requested and Recommended

- **Description**

This proposal partners USC with Santee Cooper and the electric cooperatives of South Carolina to pursue research and economic development activities with a goal of reducing the harmful environmental impact of burning coal to produce electricity and becoming a world leader in this area.

- **Strengths**

This is an impressive proposal with an excellent group of partners. The USC Chemical Engineering Department has an outstanding record of success in research and graduate education. The commitment of the $5 million match in advance of a potential award says much about the prospects for success. As one reviewer notes, "the proposed activity addresses the dichotomy between increasing electricity demands and environmental challenges, particularly carbon dioxide production and sequestration associated with the combustion of coal. This issue is so important to national interests (economic, environmental and security) that there are substantial amounts of money being invested in it by federal agencies.... The importance of the issue cannot be overstated." This statement fairly well summarizes the importance of this research and the opportunity for this center.

This partnership is another step toward making USC an international leader in future fuels/energy research. We commend USC for its strategic thinking with respect to energy and the financial commitment it has made in general and specifically to this proposal. We are excited about the possibilities that this proposal offers, and it clearly builds on the considerable strength that USC has developed over time. There is an opportunity here to change the funding picture for federal agencies with regard to more environmentally friendly coal-fired electricity generation. USC and this center will present commanding strength in many energy areas including this one. The new technologies and methodologies that are available for research today make taking a fresh look at decades old research in cleaning up coal fired electric plants a real opportunity. Coal is going to be with us for quite some time, regardless of what we begin to do in the area of alternative and renewable resources. We are pleased that a candidate for the endowed chair has been identified, and we wish USC the best in recruiting this candidate.

We do ask that the center include work on energy conservation, whether by this center itself, or the broader energy institute being envisioned. This would be a very powerful platform from which to work.

A comment from another reviewer is a good one with which to close the section on strengths. Reviewer 5 says, "This is a well written proposal. Success of the proposed research would have a huge impact on the well being of the State of South Carolina as well as the nation. The PIs are excellent researchers. A sound research plan is proposed. I would give the highest rating to this proposal."

- **Weaknesses**

This is a multidisciplinary problem. One can hardly think of an area of research that does not touch environmental and energy problems including policy, law, the physical sciences, business, journalism, etc. It is critical that this center not be viewed as a College of Engineering center. Fostering collaboration is not necessarily easy, and there are many wrong ways to try to accomplish it. All parties must have something to gain in the collaboration and all must feel that they are important partners. They must not be led to think they are just a helper or worse just being thrown a bone. We strongly recommend that the Provost and the Vice President for Research personally ensure that this center be a university-wide center and that it not at all be viewed as a College of Engineering center. We expect that the endowed chair would have the full authority to make this multi-disciplinary center happen. We will be interested in following the progress of the center in general and specifically with regard to the success that USC can demonstrate in making a multidisciplinary approach happen here. It is a great opportunity.

The external review committee would like to see a greater emphasis on graduate education, specifically recruitment of high quality graduate students and retention after graduation, through the center.

- **Recommendation**

The external review committee recommends full funding ($5 million) for this proposal.

Medical University of South Carolina/Tobacco-Related Malignancy Research
$5,000,000 Requested and Recommended

- **Description**

The goal of the research in this proposal is to identify biomarkers for tobacco-related malignancies. The funding will be used for two endowed chairs which will be supported by two additional faculty recruits and pre- and postdoctoral stipends.

- **Strengths**

This is a very strong proposal in an extremely important area which is likely to have significant impacts both clinically and economically. This center will build upon the growing excellence present in the Hollings Cancer Center (HCC), including new faculty who have been hired. It is clear that MUSC and the State of South Carolina are committed to obtaining National Cancer Institute designation as a comprehensive cancer center for HCC. HCC has set aside adequate laboratory space for this center and will provide funding for programmatic support as part of the match. Two million dollars in matching philanthropic funds are pledged by the Hollings Cancer Center. Three million dollars of programmatic grants and other matching monies will be made available by MUSC.

It is noteworthy that cancer-related biomarkers are the focus of work of several current faculty at HCC. Thus, there has been considerable thought given to initial targets being viewed as possible biomarkers for tobacco-associated cancers. For example, one line of research will explore the possibility of lipids in the blood as potential tobacco-associated cancer biomarkers.

There is a well-organized description of what the chairs will do and how the center will be organized. One endowed chair will be someone who has experience in biomarker discovery in a specific disease, e.g., lung cancer, and a strong interest in using novel technologies to find further markers. The second Endowed Chair should be able to work statewide to validate these markers and interact closely with the State's physicians to organize clinical trials to test the utility of these markers. This is an excellent plan for facilitating the goals of this center.

This center will use an integrated approach that seeks not only to discover biomarkers but uses the initial work to have a real clinical impact in the state of South Carolina. Once potential biomarkers are identified, epidemiologic techniques will be used to validate these candidates in tobacco-related malignancies. In addition, a networked tissue repository will be established at multiple medical centers throughout South Carolina. Moreover, clinical trials will be performed to evaluate the used of the new biomarkers.

It is impressive that a clinical network has already been organized which will facilitate the number of patients which can be studied. This alliance consists of nine medical centers throughout the state, the Ralph H. Johnson Veterans Administration Medical Center, the Department of Health and Environmental Control and the South Carolina Cancer Alliance.

- **Weaknesses**

The only major concern is whether MUSC will be able to compete nationally with all the programs that are working on biomarker identification. However, hiring the strongest possible endowed chair should alleviate this concern.

- **Recommendation**

The external review committee recommends full funding ($5 million) for this proposal.

MUSC/USC – South Carolina Center of Economic Excellence in Stroke $5,000,000 Requested and Recommended

- **Description**

The purpose of the Center of Economic Excellence in Stroke is to enhance the stroke program and to strengthen the clinical and basic stroke research in South Carolina. The reduction in the incidence of stroke and the provision of acute stroke care are major goals of this Center of Excellence. The support of three endowed chairs in the area of stroke (translational stroke research and clinical chemistry/drug development) will enhance the research programs at the Medical University of South Carolina (MUSC), the University of South Carolina (USC), Greenville Health System (GHS), and the Greenwood Genetics Center (GGC) that can provide the expertise to make South Carolina more competitive for multi-million dollar federal grants and contracts.

- **Strengths**

This is a strategic and innovative proposal. There are already strong assets in the area of stroke research at MUSC and strong assets in neuroimaging at USC. Several additional stroke researchers have been recently added. Most notably is Dr. Robert Adams who will accept the position as Director of the MUSC Stroke Center as of August 2007. He brings extensive experience in stroke research from the University of Georgia. He will also provide effective leadership in integrating the stroke program at multiple sites. He is the co-patent holder and developer of REACHMD, a system to provide web-based consultations to outlying sites. This system will be developed at MUSC and be an important component of this CoEE in stroke.

The CoEE for stroke is innovative in its translational approach and its utilization of multiple scientific and medical disciplines within neuroscience. Several areas of ongoing research are also novel for the field of stroke, e.g., post-stroke dementia, juvenile stroke, cognitive neuroscience such as vision and attention and language, bioengineering collaborations involving drug delivery systems, and neuronal circuit analysis.

GHS has begun construction of a Research and Education Innovation Institute, which will house academic programs from CU, MUSC, USC and Greenville Technical College. This $20 million, 100,000 ft facility will house programs in patient safety and clinical effectiveness, pharmacy, medicine and dental medicine (underdevelopment).

Greenwood Genetics Center (GGC) mainly focuses on childhood related disorders (Mental retardation, MR). However, as a part of these disorders, pediatric stroke plays an important role in the disorders associated with children. GGC has led the field in identification of the genetic factors that contribute to MR and childhood diseases. GGC will participate in research programs associated with the genetics of stroke. This is an important and least studied aspect of stroke development and progression. In addition, GGC offers research fellowships in genetics that will help in the development of high quality researchers.

MUSC is currently in discussions with several corporations to provide imaging equipment to be used in this center. Philips and Siemens are planning to establish a human research imaging facility. MUSC currently shares a Philips 3T MR with radiology for clinical and research imaging.

Dr. Mark George (co-PI of approved Brain Imaging CoEE) is a leader in the field of MR technology and this machine would provide the needed facilities for clinical trials and research grants in imaging and stroke. In addition to this facility, MUSC is establishing a Small Animal Imaging Facility (SAIF) program. This will allow for the translation of animal research to patient treatment. MUSC and USC have been very active in the development of start-up companies in the area of neuroscience and neurodegeneration. These companies are in various phases of drug discovery and development that will be able to provide new and novel compounds for the treatment of stroke.

- **Weaknesses**

The weaknesses identified with the previous submitted versions of this proposal have been addressed. The additional faculty have greatly strengthened the quality and quantity of both basic and translational research. GHS and the Greenwood Genetics Center have been more fully integrated into the entire stroke program. It is still not clear how the graduate program would be established at the Greenville Hospital, but they do have an existing program for house staff and fellows. The details of how the Stroke Registry would be set up were not provided, but Dr. Adams stated that it would be modeled after the program that he developed in Georgia.

- **Recommendation**

The external review panel recommends full funding ($5,000,000) of this proposal. This funding is partially matched by the Health Sciences of South Carolina Duke Endowment grant. This CoEE addresses an extremely important problem in the State of South Carolina. The faculty and administrators at MUSC and USC have assembled an impressive group of stroke researchers who conduct important transitional research that will lead to better prevention and treatment of this important disease.

CATEGORY 2 - MERITORIOUS, BUT WITH NEED FOR IMPROVEMENT AND RE-REVIEW BEFORE RECOMMENDATION FOR FUNDING

Proposals in this category are listed in the priority order determined by the Review Panel.

USC/CLEMSON – OLDER ADULT INDEPENDENCE

$5,000,000 Requested

- **Description**

This program proposes three chairs, two at USC (Community and Social Support; Memory and Brain Function), and one at Clemson (Senior Driving, Mobility, and Physical Functioning). The three chairs and associated research staff will work together in a multidisciplinary effort to foster independence for seniors.

- **Strengths**

The proposers have identified a critical problem for the nation and especially for South Carolina which is home to an increasing share of retirees. There have always been important quality of life issues associated with aging, and a responsible society must address these. The principal change facing us now, however, is numbers. The profound demographic shift that is underway as the Baby Boomers age will stress our physical and financial infrastructure in a way that has never been seen before. Unless we devise new ways to promote independence, the health care system, including especially nursing homes, will be hard pressed to deal with the flood of people aged 80 and older. Given that few people have insurance that will cover nursing home care, the financial burden for families of those who cannot live independently will be profound.

The proposers have also identified areas—brain function, the "smart home," and mobility—that are of obvious importance and that have strong potential for both sponsored research and commercial impact—both start-ups and the attraction of existing companies.

The Review Panel agrees with the technical and scientific reports that the personnel in place are well qualified to lead the effort and that administrative structures are in place to manage the collaboration.

- **Weaknesses**

As with many of the proposals in the Research Centers program, there is strong potential for an innovative graduate program, but the proposal provides almost no information about how this will be achieved, leading the Review Panel to the inevitable conclusion that not much thought has been given to this important issue.

The general area which older adult independence represents is highly competitive, both in research and in the development of commercial products. Given that there are centers well advanced in each of the three core areas represented, the strength of this program must be derived from its multidisciplinary nature. Unfortunately, there is insufficient evidence that the proposers have thought about how to leverage this potential. The weakly defined graduate program is one example, but the overall science of the planned effort is a concern as well. The proposal provides little information on how the existing scientific strengths at the two institutions will be marshaled to attract truly eminent researchers.

- **Recommendation**

Research in older adult independence is a critically important issue for South Carolina, representing a great opportunity to improve quality of life as well as to offset enormous financial challenges for individuals and for society. The proposers have a good general idea of how to approach this in a competitive manner, but have provided insufficient detail on how the three areas will be knit together at the scientific level. The Review Panel does not recommend funding of the proposal as it is currently written but would be open to a revision that attends to the concerns cited above.

CATEGORY 3- NOT RECOMMENDED FOR FUNDING AT THIS TIME

The Review Panel does not consider this proposal to be appropriate for funding in its current form.

CLEMSON – HUMAN GENETICS

$5,000,000 Requested

- **Description**

This proposal represents a resubmission from 2006 to request an Endowed Professorship of Human Genetics. The Endowed Chair will represent one of three planned for the South Carolina Center of Economic Excellence in Genetics, a collaboration between Clemson University and Greenwood Genetic Center. The proposed Chair in Human Genetics would complement the existing Coker Chair in Plant Molecular Genetics and would be housed in a Clemson facility on the Greenwood

campus. The objective of the proposal is to create excellence in human genetics with particular focus on human disabilities. The goals are to promote advances in biotech research technology for the initiation of new commercial ventures while providing the highly trained workforce essential for their support. The proposal requests $2 million from the state program for the Endowed Chair and anticipates attracting $2 million in matching funds from foundations, biotech companies and individual donors.

- **Strengths**

The proposal has many strengths. Most impressive is the powerful research team in plant genetics already active on the Clemson campus. The Coker Chair in Plant Molecular Genetics has real potential to build a national leadership position for Clemson in this research area. Other strengths include the facilities and resources of the Clemson University Genetics Initiative, bioinformatics and proteomics capabilities, the degree programs in genetics offered at Clemson, the important research in genetics of human disability at GGC, the South Carolina Biotechnology Incubation Facility on the GGC campus and the future CU education and research facility to be built at GGC. The review panel appreciates the value of these resources in genetics. The ongoing curriculum development in genetics was further identified as a strength, as was the commitment to ensuring a workforce pipeline at all levels. The strong track records of both CU and GGC in securing private sector commitments for infrastructure investment were also noted.

- **Weaknesses**

Despite the many strengths, the panel identified significant weaknesses and concerns that diminished enthusiasm for this proposal. The national landscape in the field of human molecular genetics has been well established for more than a decade, with strong academic leaders having staked out the field in major cities that already attract the lion's share of funding and industrial partnership. The established and fiercely competitive nature of this mature field does not lend confidence that a relatively recent entry, like the proposed partnership, can distinguish itself. Compelling evidence was lacking to indicate that the ongoing work in human genetics would be successful in attracting significant biotechnology industry to the area. Evidence was lacking that South Carolina will be competitive with other major, well-established sites of biotechnology in the field of genetics of human disease.

The connections in the proposal between plant genetics and human genetics were considered to be relatively weak. Indeed, the proposed research in genetics of human disease was not clearly aligned with the CU mission. In contrast, the Coker Chair has established real excellence with strong economic potential in the area of plant genetics. This is an area likely to reap significant benefit from further investment.

A significant gap was the absence of collaboration with a medical school or academic health center. Such collaboration would be critical for the translation of health-related discovery.

- **Recommendation**

The review panel identified and considered significant strengths and weaknesses of this proposal. Overall, the strengths are outweighed in the panel's view by the identified concerns. The Review Panel does not recommend funding for this proposal at this time. A possibility for the applicants' consideration is to reframe the proposal more broadly than Human Genetics. The rationale for an Endowed Chair in Human Genetics as proposed is not compelling.

SUMMARY OF RECOMMENDATIONS

Category One Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
Reconstructive Methodologies and Materials			1	$5,000,000
Health Facilities Design and Testing	1	1		$5,000,000
Strategic Environmental; Approaches to Electricity Production from Coal			1	$5,000,000
Tobacco-Related Malignancy Research		2		$5,000,000
Stroke		2*	1	$5,000,000
Total	1	5	3	$25,000,000

* One of the three chairs may go to either MUSC or USC; it is shown here with MUSC, the lead institution.

Part Five: Recommendations for Infrastructure

Advanced Broadband Networking

The 2005 Review Panel made a specific and detailed recommendation that South Carolina move rapidly to follow other states which have built very high bandwidth networks that use "dark fiber"—that is, where the state secures direct access to the fiber and lights it with its own equipment. This approach allows for better scalability and lower costs than existing alternatives. Last year's Panel noted considerable progress in this area, and the 2007 team is very pleased that funding is in progress for the South Carolina LightRail and that concrete plans are ready for implementation. The Panel agrees that connecting the three research universities is a logical first phase, but emphasizes that the connection of all colleges and universities as quickly as possible will be of enormous benefit to the state. Finally, the Panel believes that management of the LightRail system should remain within the higher education community: higher education's use of these systems—with greater attention to experimentation and advancement of capability—is different from that of industry and government; a more traditional management approach could hamper development.

National Science Foundation on the Value of Simulation & Modeling

"The practice of science and engineering at the research frontier has changed markedly in recent years, owing in large measure to the impact of increasingly powerful and pervasive information technology (IT). Today, simulation and modeling are as important to discovery and innovation as are theory and experimentation....

"These advances in IT are also revealing transformational opportunities to promote and advance learning, to expand and make use of discoveries in human cognition, and to enable distributed learning through enhanced access and peer-to-peer technologies."

NSF Cyberinfrastructure RFP

http://www.nsf.gov/pubs/2006/nsf06548/nsf06548.htm

Computational Science

The 2005 and 2006 Review Panels suggested that South Carolina consider an initiative in the rapidly growing field of computational science. As signaled in a recent National Science Foundation report (see text box), most scientific advances are now expected to depend on the ability of researchers to build highly complex computer models and simulations of processes such as the interaction of drugs and cells at the molecular level. Colleges and universities will also need to invest in this field if they are to be effective in assisting business and industry (see text box). To illustrate, the automotive industry is avoiding the time-consuming and extremely expensive process of building mockups of new vehicles (called "mules" in the trade) by doing as much testing as possible using computer-based models.

The Review Panel again heard some evidence of activities in computational science, but did not find information to suggest that this is as yet a major area of collaboration. The recent (April, 2007) decision by Google to invest in a major facility in the Charleston area, and possibly another near Columbia, should provide a strong incentive to leverage that company's investment in the state with collaborative investment.

Shared Computation

Now that the statewide LightRail fiber network is about to become a reality, the Review Panel believes that the state should give renewed attention to High Performance Computing (HPC—commonly also called supercomputing) and consider sharing computational resources, including mass storage and perhaps technical personnel in key areas such as coding for multi-processor systems. With the LightRail system in operation, HPC resources should be as accessible over 250 miles as they would be in the next room.

Business and Computational Science

The CEO of Procter and Gamble, A.G. Laffley, recently said, "We are significantly expanding capabilities in computational modeling and computer-aided engineering, so we can do an increasing percentage of product and process design through virtual simulation."

www.bluecollarcomputing.org/docs/IndustryWeek.pdf

Shared Scientific Infrastructure

S.C. LightRail will also enable shared access to resources beyond HPC. For example, advanced instruments such as Transmission Electron Microscopes (TEM) will be sharable in real time. The Review Team is pleased that the universities are already doing this kind of sharing in some areas, but real-time access over the LightRail will improve quality of use, and will enable sharing of not only expensive equipment but also expensive technical support (TEM staff normally have Ph.D.s).

Graduate Education

As in previous years, the Review Panel was quite surprised by the relatively sparse reference to graduate education in the proposals. As mentioned earlier, graduate students are very much at the core of successful research-economic development strategies: it is widely accepted among business and higher education leaders that the best form of technology transfer is in the minds of graduates.

We continue to believe that the three universities should consider marketing to prospective students the ability they will have to draw on faculty, instrumentation, and related resources from all three universities. One area of potential would be the availability of graduate certificates in multidisciplinary fields—perhaps the Commission staff might help the universities leverage the NSF IGERT program to this end.

The universities might also consider the idea of true, multi-university graduate programs. This would be a big and challenging step, but one that would make sense in a fiercely competitive environment. Technology, in the form of broadband networking provided by the LightRail system, is beginning to change the way people think of interacting across distance. Outstanding examples of multi-university, multi-disciplinary collaboration at the graduate level are to be found in the highly productive relationship between the University of Pittsburgh and Carnegie Mellon University.

The Review Panel believes that the best use of the nearly $10 million in interest monies available from the Research Centers of Economic Excellence program would be in providing fellowships for graduate students and postdocs in approved Research Centers. Using the funds in this way would jump-start the approved centers towards early success.

Part Six: Conclusion

The Review Panel believes that South Carolina has an exceptionally strong program in the Research Centers of Economic Excellence. Taken together, the program's two key foci, targeted, focused investment that leverages business support, plus qualities of scale through collaboration, make this a distinctive and path-breaking effort. The strong business participation, including the notable up-front pledges of cash offered in this year's program, are powerful and tangible evidence that the program is very well conceived. There is no question that the investments made in the previously and currently recommended proposals will produce extraordinary benefit for South Carolina.

Despite the great strengths of this program, South Carolina cannot assume that current achievements will assure competitiveness. The competition to be a leader in the knowledge economy is getting tougher, as more and more states and nations appreciate the need to rethink their educational and research structures. The race won't end any time soon, and it would be a disaster for South Carolina to pause, much less drop this program just as others are beginning to consider similar strategies. South Carolina needs to continue its bold, but also balanced and prudent investments in the knowledge economy.

The Review Panel believes that, in addition to retaining the Research Centers of Economic Excellence, South Carolina should actively consider expanding the program. One method of doing this would be to make the up-front and graduate student/ postdoctoral fellows investments described earlier, but do them in the form of immediate grants that do not diminish the available resources provided by the endowments. A more radical idea would be to consider investing in something like "Leading Edge Clusters" that would offer one-time, three or four-year funding for groups of junior faculty and affiliated personnel, matched on a fractional basis by the universities. After the initial three or four year period, the universities would be expected to cover the salaries with

income from federal, industrial and foundation funds. A parallel investment in personnel at partnering technical colleges could be a powerful complement to these investments. There are many other possible permutations to this approach, the key point being that South Carolina needs to continue to be active and innovative in thinking about the kinds of investments that fuel the knowledge economy.

In summary, given the demonstrated impact of cluster effects stemming from the aggregation of innovative people and an entrepreneurial climate, the Review Panel recommends that the program be continued beyond 2010 and, expanded with complementary investments that accelerate and extend its impact.

Appendix: Important Documents

South Carolina General Assembly

CHAPTER 75.
SOUTH CAROLINA RESEARCH CENTERS OF ECONOMIC EXCELLENCE

SECTION 2-75-05. Short title; legislative intent.

(A) This chapter is known and may be cited as the "South Carolina Research Centers of Economic Excellence Act".

(B) The General Assembly finds that:

(1) it is in the public interest to create incentives for the senior research universities of South Carolina consisting of Clemson University, the Medical University of South Carolina, and the University of South Carolina to raise capital from the private sector to fund endowments for professorships in research areas targeted to create well-paying jobs and enhanced economic opportunities for the people of South Carolina;

(2) these endowed professorships should be used to recruit and maintain leading scientists and engineers at the senior research universities of South Carolina for the purposes of developing and leveraging the research capabilities of the universities for the creation of well-paying jobs and enhanced economic opportunities in knowledge-based industries for all South Carolinians;

(3) in communities across the United States in which better paying jobs and enhanced economic development in knowledge-based industries has flourished, the local or state government has created incentives and made a long-term commitment to public and private funding for a significant number of endowments for professorships in targeted knowledge-based industries;

(4) the South Carolina Education Lottery provides a source of funding and an incentive for the senior research universities to raise, in dollar-for-dollar matching amounts, sums from private sources sufficient to create endowed professorships;

(5) these endowed professorships should be awarded to the senior research universities through a competitive application process, provided that the competitive process must encourage the senior research universities to submit cooperative applications with one another as well as in cooperation with other institutions of higher education; and

(6) these endowed professorships, funded equally from the South Carolina Education Lottery and from other private sources, provide a foundation for the creation of centers of economic excellence.

Section 2-75-10. There is created the Research Centers of Excellence Review Board. The board shall consist of nine members. Of the nine members, three must be appointed by the Governor, three must be appointed by the President Pro Tempore of the Senate, and three must be appointed by the Speaker of the House of Representatives. The terms of members are three years and members are eligible to be appointed for no more than two

additional terms. Of the members initially appointed by the Governor, the President Pro Tempore, and the Speaker of the House, one shall be appointed for a term of one year, one for a term of two years, and one for a term of three years, the initial term of each member to be designated by the Governor, President Pro Tempore, and Speaker of the House when making the appointments. The Governor, the President Pro Tempore, and the Speaker of the House shall appoint persons with substantial experience in business, law, accounting, technology, manufacturing, engineering, or other professions and experience which provide an understanding of the purposes of this chapter. The board shall be responsible for providing annually to the Commission on Higher Education a schedule by which applications for funding are received and awarded on a competitive basis, the awarding of matching funds as provided in Section 2-75-60, and for oversight and operation of the fund created by Section 2-75-30. The review board must provide an annual report to the Budget and Control Board, which shall include an audit performed by an independent auditor.

Section 2-75-20. The presidents of the senior research universities shall serve as ex officio nonvoting members of the board.

Section 2-75-30. There is created the Centers of Excellence Matching Endowment. The endowment must be funded annually by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200,000,000 by 2010. The fund must be managed by the State Treasurer, subject to awards from the endowment as provided in this chapter. Interest earnings of the endowment must remain in the fund.

Section 2-75-40. The senior research universities, individually, in conjunction with one or more other senior research universities or with other South Carolina higher education institutions, may make application for awards from the endowment as provided in this chapter.

Section 2-75-50. An application for an award from the endowment shall:

(1) provide to the board documentation of private matching funds, on hand, in an amount equal to the amount for which application is made;

(2) provide to the board documentation that all matching funds have been committed and raised exclusively from sources other than South Carolina tax dollars, and that the funds have been committed and raised after January 1, 2002;

(3) be in an amount of not less than two million dollars and not more than five million dollars;

(4) document that the application has significant potential to provide for enhanced economic development for the citizens of South Carolina in a specified knowledge-based industry or field of commerce; and

(5) provide specific partnering activities with other institutions, businesses, or the community.

Section 2-75-60. Upon a determination by the board that the provisions of Section 2-75-50 have been met, the board must appoint a panel of experts chosen from outside South Carolina for their expertise in the respective research field to review the application. The members appointed to the panel shall have no affiliation with the senior research universities. The panel will convene in the State to review the proposals and to conduct site visits to ensure that appropriate research infrastructure exists at the applying university. The panel shall make a report and recommendation to the board as to the merits of the application not more than ninety days after submission to the panel. The board shall then make a determination as to whether or not to award the matching funds and the amount of the award.

Section 2-75-70. Staff and support for the operations of the board and the panels must be provided by the Commission on Higher Education. The Commission on Higher Education shall approve all necessary funds for the prudent operation of the board, including per diem, subsistence, and mileage expenses of board members as provided by law for members of state boards, committees, and commissions, and for the costs and expenses of the panel members. The expenditures authorized by this section must be provided from the fund created by Section 2-75-30 upon approval by the commission.

Section 2-75-80. If any section, subsection, paragraph, subparagraph, sentence, clause, phrase, or word of this chapter is for any reason held to be unconstitutional or invalid, such holding shall not affect the constitutionality or validity of the remaining portions of this section, the General Assembly hereby declaring that it would have passed this section, and each and every section, subsection, paragraph, subparagraph, sentence, clause, phrase, and word thereof, irrespective of the fact that any one or more other sections, subsections, paragraphs, subparagraphs, sentences, clauses, phrases, or words hereof may be declared to be unconstitutional, invalid, or otherwise ineffective."

Source: www.scstatehouse.net/code/t02c075.htm

South Carolina Research Centers of Economic Excellence
Summary of Purposes and Goals

During the 2002 legislative session, the South Carolina General Assembly passed the *South Carolina Research Centers of Economic Excellence Act*. With an allocation of $30 million in lottery funds, to be matched on a dollar-for-dollar basis with non-state funds, the General Assembly established a competitive grants program to award to South Carolina's three research universities funds endowed professorships in areas that will enhance economic opportunities for the state's citizens.

The Act created the *Centers of Economic Excellence Matching Endowment*, which is to be funded annually by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200 million by 2010. Moreover, the Act established the *Research Centers of Excellence Review Board* consisting of twelve members; the Commission on Higher Education provides staff assistance to the Board. The *Board* is responsible for awarding state matching funds, for oversight and operation of the fund, and for various accountability requirements established in statute for the program.

The legislation establishing this program is very explicit as to its purpose:

> "It is in the public interest to create incentives for the senior research universities of South Carolina consisting of Clemson University, the Medical University of South Carolina, and the University of South Carolina to raise capital from the private sector to fund endowments for professorships in research areas targeted to create well-paying jobs and enhanced economic opportunities for the people of South Carolina.
>
> "These endowed professorships should be used to recruit and maintain leading scientists and engineers at the senior research universities of South Carolina for the purposes of developing and leveraging the research capabilities of the universities for the creation of well-paying jobs and enhanced economic opportunities in knowledge-based industries for all South Carolinians" (Section 2-75-5).

As made explicit through the legislation title, the intent of the program is to create a critical mass of senior researchers around whom a Center of Economic Excellence can be built. Such a Center will include other senior and junior faculty, graduate students, and public/private partnerships with business and industry. Through research and its eventual application, the clear expectation of the act is that job creation and other economic stimuli (e.g., patents, licenses) will result over time.

The legislation acknowledges the success of other communities in creating economic opportunity through knowledge-based industries by providing, through state or local governments, incentives and a long-term

commitment to public and private funding for "a significant number of endowments for professorships in targeted knowledge-based industries" (Section 2-75-5). The program's stated intent is to provide $30 million from lottery funds to be matched by the institutions on a dollar-for-dollar basis by non-state funds each year through the year 2010.

The legislation stipulates that awards are to be made through a competitive application process which encourages collaboration among the three research institutions as well as cooperation with other higher education institutions. Funding decisions are to be made by the nine-member Centers of Economic Excellence Review Board, three members of which are appointed by the Governor, the President Pro Tem of the Senate, and the Speaker of the House respectively.

Source: http://www.endowedchairs.org/Program_purposes_and_goals.pdf

South Carolina Research Authority (SCRA)

At SCRA and our affiliated institutes, we develop technology solutions to meet the complex needs of customers in government and business.

To do that, we assemble multi-organization teams that can include governmental groups, universities, major corporations, technology companies, consultants and our own staff of specialists in disciplines ranging from computer science to advanced metallurgy.

Working with these collaborative teams, we identify applicable technologies and use innovative strategies to adapt them to client needs. In addition, our projects often make use of SCRA capabilities to ensure that customers are able to implement and use the new technologies effectively.

In our 21 years of operation, SCRA and our affiliated institutes have emerged as international leaders in this unique field of consortium management, attracting more than $68 million in annual revenue. Current customers include groups within the Department of Defense, Department of Justice, Department of Transportation, Department of Energy, and Department of Commerce as well as private industry, medical centers, state and regional transportation departments, and security/law enforcement agencies.

SCRA also works to enhance research infrastructure within South Carolina. We support the efforts of faculty at state academic centers to secure project grants and build new capabilities, and we manage a system of research parks that attracts technology companies. These parks are now home to 40 technology-oriented firms employing nearly 6,000 people.

Source: www.scra.org

Information on the Centers of Innovation can be found at
http://www.scstatehouse.net/sess116_2005-2006/bills/3794.htm

Health Sciences South Carolina

Health Sciences South Carolina is a public-private collaborative partnership between two of South Carolina's leading universities, the Medical University of South Carolina (MUSC) and the University of South Carolina (USC), and the state's largest health systems, Palmetto Health and Greenville Hospital System.

The mission of Health Sciences South Carolina is to advance health sciences research, education, and public health in the Palmetto State. Each of the four partners has agreed to invest $2 million per year for 10 years in health sciences research, an investment of $80 million. Matching dollars from the South Carolina General Assembly through the Life Sciences Act raise the total investment to $160 million.

Since the collaboration was formed in April 2004, GHS has made a series of announcements made possible in part by Health Sciences South Carolina. Click the link below for press releases related to this historic initiative.

Source: http://147.202.35.75/hospital/10057/

South Carolina Centers of Economic Excellence
Review Panel Report

May 16, 2008

The Site Review Panel visited the Clemson University International Center for Automotive Research (CU-ICAR,) the University of South Carolina at Columbia and the Medical University of South Carolina on consecutive days May 4-7, 2008. During this visit the panel heard presentations from individuals at each campus who had submitted proposals to the South Carolina Centers of Economic Excellence (CoEE) Review Board. Following panel deliberation both in person and via teleconference, the merits of each proposal were assessed.

This document presents the findings and recommendations of the Review Panel and is organized as follows: **Part One** provides an overview of the Endowed Chairs program; **Part Two** provides general findings and recommendations from the Review Panel; **Part Three** offers suggestions on improving program operation including suggestions for additional funding and infrastructure needed to support the CoEE program. **Part Four** describes the Panel's recommendations for funding based on their review of the 2007-2008 proposals; and **Part Five** offers a summary conclusion from the Panel.

Part One: Program Overview

Program Description and History. During the 2002 legislative session, the South Carolina General Assembly passed the *South Carolina Research Centers of Economic Excellence Act*. With appropriations in lottery funds of $200 million through 2010 to be matched on a dollar-for-dollar basis with non-state funds, this competitive grants program awards to South Carolina's three research universities funds to establish Endowed Professorships in areas that will enhance economic opportunities for the state's citizens. The program is funded by appropriations from the South Carolina Education Lottery Account in an aggregate amount not to exceed $200 million by 2010.

Awards are made through a competitive application process which encourages collaboration among the three research institutions and with other higher education institutions in the state. Funding decisions are made by a nine-member Centers of Economic Excellence Review Board, three members of which are appointed by the Governor, the President Pro Tempore of the Senate, and the Speaker of the House respectively.

Current Program Status. The program is currently in its sixth year of soliciting and reviewing proposals from the state's three research universities. This year 11 proposals were submitted to the Review Panel for evaluation.

Over the last five years the Review Board has approved funding for 34 research proposals from USC (10), MUSC (12), and Clemson University (12) and their partner-institutions, totaling $144 million in state lottery funds. To date over $60 million in lottery funds have been drawn down and distributed to the institutions, and the institutions report just over $119 million in matching fund pledges, of which $70.6 million has been received.

The 34 Board-approved Research Centers represent a diverse palate of research fields. A complete list of the funded centers is appended to this report. A number of Centers also represent collaborative efforts among the state's three research universities.

The 2007-2008 funding cycle included 5 individual and 6 collaborative proposals:

Institution(s)	**Project Title**	**Amount Requested**	**Chairs**
Clemson	Optoelectronics	$2 million	1
Clemson	Cyber-Institute	$2 million	1
Clemson/USC/MUSC	Health Facilities Design & Testing (Phase II)	$5 million	2 (1 Clemson, 1 USC)
USC	Nanoenvironmental Research & Risk Assessment	$ 3 million	1
USC	Nuclear Science & Energy	$ 3 million	1
USC/MUSC	Translational Biosciences	$ 5 million	1 (USC)
MUSC/USC/Clemson/ SC Bioengineering Alliance	Advanced Tissue Biofabrication	$5 million	3 (1 MUSC, 1 USC, 1 Clemson)
MUSC/SCSU/USC	Cancer Disparities	$5 million	3 (1MUSC, 1 SCSU, 1 USC)
MUSC/Clemson/Health Sciences SC	Cancer Stem Cell	$5 million	2 (MUSC)
MUSC	Renal Disease Biomarker	$5 million	2
MUSC/USC	Medication Safety and Efficacy	$5 million	2 (1 MUSC, 1 USC)
TOTALS	**11 Proposals**	**$45 million**	**19**
	Available 2007-08 funding	**$36 million**	

Evaluating the Proposals. The process of assessing the quality and viability of each proposal proceeded in several phases. The first phase involved submitting the proposals via e-mail to external reviewers to determine the technical and scientific merit of each research project. The goal of this process was to obtain a minimum of four technical reviews: two from reviewers recommended by the institution submitting the proposal, and two from acknowledged experts in the field who have not been recommended by the submitting institution. Reviewers were asked to assign points to the proposal in each of four categories: Scientific and Technical Merit (up to 40 points); Approach, Process, and Execution (up to 25 points); Innovation (up to 25 points); and Infrastructure, Support, and Collaboration (up to 10 points). The maximum point total is 100.

Each proposal was assigned a lead reviewer and a secondary reviewer from the Site Review Panel. The role of the lead reviewer was fourfold: 1) to write questions to the principal investigator about the proposal for submission prior to the visit; 2) to serve as the effective chair of the Panel for that proposal, including taking the lead in formulating questions; 3) leading the Panel's internal discussion and ranking of the proposal during deliberations; and 4) drafting the narrative section required for the final report. The second reviewer provided reinforcement and support for the lead reviewer assigned to each proposal.

At the conclusion of each day's campus visits the Review Panel convened to discuss the proposals and begin drafting a preliminary report. During subsequent weeks, under the guidance and direction of Panel Chair Waldrop, the Panel communicated via telephone and e-mail to arrive at final conclusions and funding recommendations. The 2007-08 Review Panel included the following consultants:

Name	**Title**	**Institution**
Jack Burns, Ph.D.*	Vice President Emeritus Academic Affairs& Research	University of Colorado
Laura S. Levy, Ph.D.*	Associate Senior Vice President for Research	Tulane University
Richard Linton, Ph.D.*	Vice President for Research & Graduate Studies	University of Oregon
Maria Pellegrini, Ph.D.	Vice President for Research	Brandeis University
James Roberts, Ph.D.*	Former Vice Provost for Research	University of Kansas
Todd Sherer, Ph.D.	Assoc. Vice President for Research & Director of Technology Transfer	Emory University
Tony G. Waldrop, Ph.D.* Chair – Review Panel	Vice Chancellor for Research and Economic Development	University of North Carolina at Chapel Hill

*Returning Review Panel Members

Part Two: General Findings and Recommendations

The Centers of Economic Excellence 2007 Site Review Panel conducted a visit to Greenville (Clemson), Columbia (USC), and Charleston (MUSC), on May 4-7, 2008. As usual, the staff of the South Carolina Commission on Higher Education provided exemplary support. In addition, the participating universities and the collaborating organizations ensured an environment which was well-organized and highly informative. Taken together with the extensive documentation provided in advance, the Site Review Panel believes that it had access to sufficient information to make recommendations for funding. Those recommendations are provided in detail in Part Four of this report.

This year the Site Review Panel asked to meet with some of the CoEE Endowed Chairs to get an impression of the quality of the recently hired professors as well as to hear from them about why they had been recruited to their respective universities in South Carolina. The Review Panel was extremely impressed with these individuals. It should also be noted that there was a very strong statement about the importance of the Centers of Excellence Program in attracting them to South Carolina.

The Site Review Panel also asked for a tour of facilities that have been constructed to support this program. A tour was given through the Campbell Graduate Engineering Center at CU-ICAR in Greenville, through the Discovery I Research Building at the University of South Carolina and a tour of the MUSC campus to see a building being renovated for a COEE and the building site for a Drug Discovery building. These buildings are a visible and very strong indication of the support of the State of South Carolina to economic development.

The extensive documentation on the CoEE program, together with the opportunity to interact with university personnel and representatives of affiliated organizations, also provided the Review Panel with an opportunity to comment on the overall purpose, structure, and foundations of the program.

Success of the S.C. Centers of Economic Excellence Program

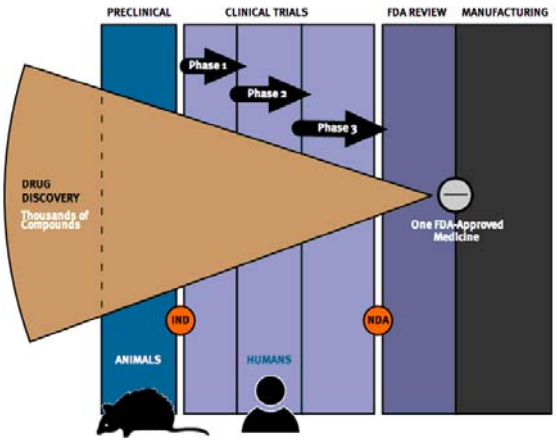
The Site Review Panel is very impressed with progress that is being made in attracting high quality faculty for Endowed Chairs. It is very evident that strong progress is being made in reaching the intended goals of this program related to economic development. Already, many outstanding endowed professors and junior faculty have been recruited to South Carolina and have brought in grants totaling well over $30 million. In addition, a number of spin-off companies have been formed from CoEEs. These include FirstString, which markets wound repair technology, and Cephos Corporation, which is involved in brain imaging technology. It should also be noted that the presence of CoEEs has attracted existing companies to establish a presence in South Carolina. Examples include the Timken Company, BMW and Michelin which have all located corporate teams and offices at Clemson's ICAR campus. It is estimated that approximately 200 jobs will result from the Timken involvement alone.

The CoEE program has had several impacts that are not directly economic in nature but downstream will lead to extraordinary effects on the economy of South Carolina. There is exceptional collaboration taking place among the three research universities that was weak prior to this program. The joint School of Pharmacy (USC & MUSC) is a prime example of this cooperation. Other examples of CoEE-induced changes include the Health Sciences South Carolina (HSSC) program, the clinical trials networks formed and the eIRB that has been established. Bringing closer research faculty, clinicians and the corporate sector together throughout South Carolina has provided a rich environment for the creation of new research programs, new clinical treatments and partnerships which can result in spin-off companies as well as improvement in the quality of life for all South Carolina citizens. The National Association of State Universities and Land Grant Colleges has provided information about the economic impact of state funding provided to universities (See insert). These effects are very much at play in South Carolina.

The Economic Impact of Public Universities
NASULGC Survey 2001

- *The average return on every $1 of state money invested in a public university is $5*
- *For every $100 spent directly by a public university, its employees , visitors and students spent another $138 of their own funds*
- *For every job on a public university campus, another 1.6 jobs are generated beyond the campus*

It should be noted that efforts such as the CoEE program take time to reap overwhelming rewards in job creation. For example, Centennial Campus at North Carolina State University and Research Triangle Park took at least 10 years before exerting a significant impact on the economy of the region and the State of North Carolina. The success of both these programs depended in no small part on enlightened leadership which understood the need for initial investment for long-term payoff.



Another indication of the time necessary for return on the investments made in research comes from the pharmaceutical industry (see insert). It is estimated that the time line for drug discovery and development of a drug to market can take 12-15 years. This process includes the basic research and the required animal and human tests.

The Site Review Panel is very impressed with the increasing quality of proposals that are being submitted. In the first couple of years of the CoEE program, there was considerable variation in the quality of Centers being proposed. However, individuals who have been on the Site Review Panel for several years have noted that most of the

proposals are now of very high quality. This results from the enhanced effort of the University leadership to evaluate and screen proposals more closely before submission for consideration. In addition, several of the current proposals benefitted from the input of recently recruited CoEE Endowed Chairs.

This year it was clear that the Universities have developed a strategy to focus on areas of major strengths instead of creating a wide diversity of centers. Extensive proliferation of centers which do not relate to ones already established could be a strategy for failure. This type of effort could result in thin infrastructure in a wide variety of efforts. Instead, it is evident that new proposed Chairs will focus on enhancing areas of interest in which the funded CoEEs have already established strength and expertise. University leadership stated that it was looking at establishing major centers underneath which several CoEEs would be managed. The Site Review Panel strongly endorses this approach.

The Site Review Panel is very aware that the CoEE is up for renewal of funding by the State of South Carolina this coming year. We believe with utmost enthusiasm that this program should be continued. As noted above, it is very clear that much of the basic foundation has been created to spur economic development in the State. Continued investment will evoke considerable returns on these initial efforts.

Part Three: Suggestions on Improving Program Operation

The Site Review Panel has been very impressed with the structure and operation of the Centers of Economic Excellence Program. The Site Review Panel continues to have ideas about how the CoEE program could be improved, however, and has provided the following thoughts on a variety of topics.

Up-Front Funding

As noted in last year's report, there are considerable costs associated with recruiting world-class faculty as Endowed Chairs. Most research universities are now investing $2-$3 million to be expended over a period of 1-3 years for recruitment of a new faculty member. Recruitment costs include salaries for junior faculty, postdoctoral trainees, students and staff who will accompany the Endowed Chair to South Carolina as well as specialized equipment and laboratory renovation. It is believed that these costs are now starting to stretch the financial capability of the Universities. The Site Review Panel is concerned that the Universities will have to limit the number of proposals that could be submitted for consideration due to this financial hardship. We recommend that the State consider mechanisms to provide assistance with the direct costs needs in support of faculty recruited to endowed chairs.

Promotion and Tenure

This issue was raised last year. The text below was in last year's report and still needs to be addressed:

The research universities in South Carolina should be encouraged to develop policies and procedures that reward success in technology transfer in the academic promotion and tenure process. Clearly, not all faculty should be expected to be involved in entrepreneurial activities. However, consideration should be given to those who do participate. Traditionally, the promotion and tenure process awards academic measures of success including peer-reviewed publication and sponsored research awards; however, such measures of technology transfer as patent applications, licensing agreements and patent impact are frequently not considered. While the Site Review Panel strongly supports the use of traditional academic metrics for promotion and tenure at South Carolina's research universities, acknowledgement of success in technology transfer activities should be considered as well if it is an explicit objective of the state for its academic institutions.

Another area for consideration by the promotion and tenure committee is for acknowledgement of participation in multidisciplinary teams. Many universities are now using this as one criteria considered in evaluation. Again, this should not be required of all faculty but considered for those who have significant impact as part of a team of researchers.

Electronic Reviews

Each year, proposals are sent electronically to external reviewers for assessment of the technical and scientific merit of each proposal. The Site Review Panel feels that these reviews are, at best, of only limited value. The quality of the reviews varies greatly and in many cases there is not agreement among the reviewers of the individual proposals. The staff at the South Carolina Commission on High Education spends a considerable amount of time seeking to identify appropriate reviewers. The Site Review Panel recommends an examination of this step to determine if there might be a better process.

Technology Transfer

Since economic impact is the ultimate goal of the Centers of Economic Excellence Program, it is crucial that the infrastructure for supporting technology transfer out of universities continues to mature as research grows on the three campuses.

The technology transfer process has a number of critical components which all have to function smoothly in order for successful flow to the market place. It is exceedingly important that each step of this process be fully developed. Failure to do so will retard or even prevent reaching the ultimate goal of economic impact.

Two critical components needed to support the commercialization of intellectual property derived from the universities are seed funding and venture funding. The latter is well underway with the

Venture Capital Investment Act of South Carolina. Pre-seed and seed stage funding also are critical to enable moving intellectual property out of the universities. In their earliest stages of development, startup companies often require relatively small amounts of funding, $50K-$200K, to complete crucial tasks such as the creation of a business plan or prototype development. The Site Review Panel has urged South Carolina to consider a specific pool of funding to move ideas across the "valley of death," including the possible creation of innovation funds supported by private investment and tax credit incentives being implemented in other states.

As the infrastructure facilitating commercialized research continues to evolve in South Carolina, the Review Panel suggests that it is very timely to review several policy aspects of critical importance to effective technology transfer and intellectual property management, as follows:

- Considering the extent of collaborative engagement in the emerging CoEE programs, it is especially critical to make sure that multi-institutional concerns are addressed with respect to ownership, rights, sharing, stacking, or bundling of IP to optimize the technology transfer process and to enhance societal applications and impact.

- Management of both individual conflict of commitment and financial conflict of interest (CoI) is of growing concern nationally. For example, the Senior Research Officers of the AAU institutions recently indicated these issues as among the primary concerns facing the nation's premier research universities. In light of South Carolina's major investment in endowed chairs who are expected to catalyze translational research at the public/private interface, it is imperative to have effective policies in place to protect such faculty investigators, from the initial disclosures of potential conflicts, to the creation of effective management plans to address them. Additional concerns relate to the management of potential conflicts for individuals serving on executive or advisory boards for the various economic centers of excellence and associated initiatives.

- Because of the growing ties between the universities and the private sector, it is also important to develop and implement policies related to institutional conflicts of interest. A policy on institutional holding and management of equity stakes in university-derived spin-offs is a related item that deserves careful scrutiny. It was apparent to members of the Review Panel that additional work is needed on both individual and institutional CoI policies and implementation in South Carolina.

As noted in previous Site Review Panel reports, it is very important that metrics for evaluating the success of transfer of research into commercial products be established. The Review Panel was pleased to receive, in advance of our site visit, a report of several indices of technology transfer. We hope this can be continued and expanded.

The Site Review Panel is well aware that it typically takes five years or more for successful commercialization of university intellectual property. In response to the recommendations of 2006, the Review Panel was delighted to see the universities presenting standard measures (such as invention disclosures, patents filed, patents received, licenses issued, licensing income, start-ups) of technology transfer. Such metrics should continue to be evaluated on a yearly basis and supplied by the three research universities to the Review Panel prior to the site visit, including those used in the Association of University Technology Managers' (AUTM) annual licensing survey. Examination of these indices, especially when they are normalized to the level of research expenditures, will continue to help in the analysis of the success of the Centers of Economic Excellence Program. The CoEE programs also are encouraged to think creatively and to examine best practices in other states to better capture the broader societal impacts of the targeted state investments.

Reporting on Program Success

The Review Panel is pleased to see that the South Carolina Commission on Higher Education has an enhanced website (www.sccoee.org) for the Centers of Economic Excellence program which provides considerable information concerning the nature of the program as well as the impacts that has already taken place. In this one location, there is a history of the program, a list of current centers and chairs and, most importantly, information about program successes, including economic impact and spin-off companies. It is important that this website be updated frequently so that anyone can see the latest impacts of CoEEs. A useful addition to this would be a report specific to each of the three universities.

Graduate Education

As in previous years, the Review Panel was quite surprised by the relatively sparse reference to graduate education in the proposals. As mentioned earlier, graduate students are very much at the core of successful research-economic development strategies: it is widely accepted among business and higher education leaders that the best form of technology transfer is in the minds of graduates. We urge the Universities to consider this in preparing proposals for next year.

Part Four: Recommendations for Funding

The Review Panel has provided three general rankings for the proposals it reviewed:

CATEGORY 1, for immediate funding.

The Review Panel believes that programs listed here are already of high quality, have clearly defined goals and objectives, have most of the key resources for success in place and, if awarded one or more endowed chairs, should find the needed match reasonably quickly and move quickly to greater success. Proposals in this category are *not* rank-ordered.

CATEGORY 2, meritorious, but with one or more significant failings that could be remedied. Resubmission is **encouraged but should require a significantly revised proposal for examination by the Review Panel prior to receiving funding.**

These proposals are similar to those in Category 1 in many ways but require at least one significant change prior to being funded. The Review Panel has tried to state clearly the change or changes that are needed, but does not believe that funding should be provided without further external review to determine whether the problems have been resolved. Proposals in this category *are not* rank-ordered.

CATEGORY 3, having serious or structural flaws. Resubmission is not encouraged without important re-conceptualization and clarification that would be equivalent to a new proposal.

The Review Panel believes that these proposals require substantial rethinking and would not recommend funding even if revised. Instead, new proposals could be advanced in the next competition. Proposals in this category are *not* rank ordered.

Recommendations on the Individual Proposals

CATEGORY 1 - RECOMMENDED FOR IMMEDIATE FUNDING- ($25 MILION)

The Review Panel did not assign a ranking to proposals within this category.

Clemson University – Cyber-Institute Center of Economic Excellence
$2,000,000 Requested and Recommended

- **DESCRIPTION**

This proposal would fund an endowed chair in cyber infrastructure (CI) who would bring together CU faculty with strength in this area to produce a strong research program, industrial partnerships, and technology transfer opportunities. The vision is for a rapid prototyping facility that would serve as a test and evaluation facility. The goal of CI in general is to enable research that relies on storage, processing, and transmission of large amounts of data.

- **STRENGTHS**

When discussing strengths, one must start with Clemson's recruitment of Jim Bottum, a national leader in this area. His presence not only adds to the overall capability but also will certainly be a factor in being able to recruit a top individual to fill the endowed chair position. He has already recruited other strong people to Clemson. In many ways, he makes the proposal.

The Cyber-infrastructure that Clemson has in place is impressive. And with the connectivity across the state and the connection to National Lambda Rail, Clemson and South Carolina will be in an enviable position. The ability to bring 40 Gb/s to a faculty member's desk is impressive. We particularly liked Provost Helms' comment that Clemson is bringing the backbone to the faculty rather than building it and hoping they come. It is also farsighted to have worked out a deal with Duke Energy for powering the central system in that the electric power consumed by these large CI central facilities is not trivial.

Mr. Bottum did an excellent job of answering the questions supplied in advance, any concerns raised in the written reviews, and those answered during and after the presentation. They have a good start in CI funding campus-wide with $3.5 million in federally sponsored research.

Because CI is an enabling technology, it could be difficult to measure specific outcomes. Nevertheless, Mr. Bottum is confident that there will be significant tech transfer activity stemming from the CI activity and they will use this as a measure of success. (Right now, 84% of CU's tech transfer activity is from the IT community.) We commend CU for this approach. When asked for his definition of a "grid," Mr. Bottum answered that it consists of organizing communities. This is a strong statement of his commitment to enabling research with the very best technology.

Organizationally, the new endowed chair will report to Bottum but also be a faculty member in Electrical and Computer Engineering. In addition, the new endowed chair will be housed in the IT building. These are all positive moves that will support the success of the endowed chair in particular and Clemson and South Carolina in general.

- **WEAKNESSES**

This is not really a weakness but rather a caution. The CI situation at the home university of one of the external review committee members is a good example of what *not* to do. Several informatics faculty members were hired with new money coming to the university, but they were scattered to multiple departments and have not interacted well. In addition, the university CI leader is not a Jim Bottum type, so in the end the CI needs of the research community are not being met. Again, this is only a caution. Clemson should be commended for doing it right, but beware of fragmentation, homegrown efforts, and direction that is counter to the research community's needs. Stay the course.

- **RECOMMENDATION**

Overall, this is an impressive proposal that was followed by an impressive presentation. The probability of success is high for this effort, and it is most timely. The external review committee recommends full funding ($2 million) for this proposal.

Clemson University – Center of Economic Excellence in Optoelectronics – $2,000,000 Requested and Recommended

- **DESCRIPTION**

This proposal would fund an endowed chair in optoelectronics who would bring together CU faculty with strength in this area to produce a strong research program, industrial partnerships, and technology transfer opportunities. As Dr. Dawson, the chair of the Electrical and Computer Engineering department, pointed out, if the last century was the century of the electron, then this century is the century of the photon. Clemson has built relationships with industry and is building on strength with this CoEE proposal.

- **STRENGTHS**

This is an area of intense research interest in the United States. Other states have succeeded with university and industry partnerships in creating clusters, and South Carolina has the opportunity to duplicate this. The external review committee is pleased that the proposed endowed chair will organizationally be part of the COMSET center. This will be truly taking advantage of the critical mass that Clemson has in the optical area. President Barker has stated his aversion to a proliferation of centers, and the Panel agrees with him wholeheartedly. It is important that the COEE program itself doesn't in some way guide the universities in that direction, because strength will come with numbers. Following on this theme, the center plans to propose an optical networking endowed chair next year if this proposal is successful. They have identified a potential candidate for the endowed chair.

The economic development outcomes of the proposed chair will follow the successful COMSET model over the last 8 years. Another important sign is that the ECE department is hiring additional photonics faculty members with the intention that the proposed endowed chair will be the leader.

The show of strength by industry during the presentation was impressive. A strong sign of support is the $1 million from industry that has already been pledged in support of this endowed chair. They have identified a target donor for the second $1 million, and they think they can close the deal in 6-12 months.

The external review committee also applauds the stated approach of not duplicating expensive equipment and facilities when other area institutions have the capability. We are also impressed with the Clemson spirit of collaboration and their dedication to breaking down barriers to collaboration.

- **WEAKNESSES**

The industrial partners talked about funding the university to test and evaluate new equipment and practices (most likely a work-for-hire arrangement) and providing summer internships for students. These are important and worthwhile parts of a balanced portfolio. Most likely, much of the actual research funding will come from the federal government, and we recommend that the institution continues to aggressively push for

federal funding using its industry relationships as leverage. Also, ensure that the Endowed Chair is a good match with industrial strengths in South Carolina. The panel trusts that Clemson is pursuing these points but wishes to emphasize their overall importance. This will create a balanced, matched, and thus very potent portfolio that will serve students and the people of South Carolina well.

When asked to hypothesize one or two potential areas of research concentration, the answers were fabrication and bioengineering. The fabrication concentration would seem to be a good fit for all parties and strength in fabrication is a Clemson goal, but bioengineering doesn't seem to fit well with the two industry partners that spoke.

- **RECOMMENDATION**

This is an excellent proposal. The center will add to an area that Clemson is establishing as a major strength and has a high likelihood of success. Half of the matching funds are in-hand, and a candidate for the endowed chair has been identified. These are strong indicators of success for the proposal. The plan is well thought out. In the panel's opinion, this is an excellent, winning proposal. Even with CoEE funding, the panel would like to suggest that these successful proposals still need startup funds for the endowed chairs, which the total award package may not completely. Nevertheless, it is important to move ahead on this effort, and the external review committee recommends full funding ($2 million) for this proposal.

University of South Carolina/ Nanoenvironmental Research and Risk Assessment -- $3 Million Requested and Recommended

- **DESCRIPTION**

This proposal requests funding for an endowed professorship in Nanoenvironmental Research and Risk Assessment as the foundation for a South Carolina Center of Economic Excellence (CoEE). The Center will focus on the impacts of nanotechnology on the environment through multidisciplinary studies addressing scientific, technological, economic, legal and societal implications.

- **STRENGTHS**

The University of South Carolina (USC) and the state of South Carolina have a compelling opportunity to provide national leadership in nanoenvironmental research that leverages USC's existing research excellence and infrastructure, expands on extensive partnerships with federal agencies and laboratories, and connects interdisciplinary platforms and outreach programs essential to the design and analysis of high quality environmental impact studies.

This proposal is a timely and important addition to USC's evolving strengths in the clean technology/energy and nanoscience research clusters. When combined with the recently appointed endowed chairs in nanoelectronics and in nanocomposites associated with USC's NanoCenter, South Carolina is well positioned to make major contributions at this critical juncture in the development of nanotechnology-enabled products.

There is a growing demand for specifically tailored environmental services in nanotechnology manufacturing and product assessment that also could be served by the emergent CoEE. Over the next decade, the value of nanotechnology is expected to surpass $1 trillion, thereby requiring that risk assessment tools are developed to assure that socioeconomic benefits are delivered without unacceptable risk of deleterious effects on living systems and the environment.

The proposal presents a balanced, life-cycle approach to nanoenvironmental research, including considerations of materials chemistry, manufacturing processes, end use applications, environmental fate and recycling approaches. The proposal builds on a critical mass of approximately 15 USC principal investigators already involved in nanoenvironmental projects, and appears to be an excellent fit to the USC "culture" encouraging multidisciplinary and integrative approaches to address key societal concerns. There is substantive engagement from academic fields as diverse as the physical sciences, health sciences, business, social sciences, and humanities.

The CoEE also will leverage the extensive facilities associated with USC's NanoCenter and the recently established Keck Laboratory for nanobioparticle research. In addition, access to a broad range of facilities and researchers would be provided through collaborations with other universities in the region (e.g. North Carolina State, Georgia Tech, Purdue) and from two national laboratories (Savannah River National Laboratory and Idaho National Laboratory). The proposed CoEE in nanoenvironmental research provides a diversity of economic development opportunities and associated business models through supporting the efforts of state and federal agencies, in serving both small and large company R&D partnerships, and in providing "fee for service" operations involving environmental risk assessments of emergent nanotechnologies.

- **WEAKNESSES**

Two significant research "gaps" in the technical aspects of the proposal include:

1. the limited capacity for *predictive modeling* related to biological and environmental fate and transport of nanomaterials, and
2. the limited capacity to *identify and control the physico-chemical properties of nanoparticles* (size, shape, surface coatings, aggregation state, etc.) with sufficient precision to conduct systematic studies of environmental impact and risk.

It will be critical to the ultimate success of the proposed CoEE to address these technical concerns if the work is to be truly innovative and "leading edge."

The opportunities for obtaining the private match and industry engagement are significant, but not well established in the proposal. It is important to construct a targeted strategy to develop substantive and economically impactful industry partnerships.

Finally, there is escalating national competition for very limited federal funds in nanoenvironmental research and development. Clearly, the CoEE must add its voice to the national dialog to help assure that adequate funds are provided to exploit this market opportunity involving "green to gold." Filling the endowed chair, despite the significant challenges of recruitment in this newly emergent nanoenvironmental field, will expand the opportunity for USC to provide critical leadership at the intersection of university-industry-government interests.

- **RECOMMENDATION**

The external review committee recommends full state funding ($3,000,000) as requested for this proposal.

University of South Carolina-- Nuclear Science and Energy
$3 million Requested and Recommended

- **DESCRIPTION**

This proposal requests funding for an endowed professorship in Nuclear Power and Advanced Materials as the foundation for a Center of Economic Excellence in Nuclear Science and Energy.

- **STRENGTHS**

The proposed CoEE is a timely and important addition to USC's impressive, growing strengths in their energy research cluster. When combined with their endowed chairs in clean coal technology approved last year along with chairs in various fuel cell technologies, the nuclear power and advanced materials chair will make South Carolina a national force in researching solutions to the U.S. energy crisis. The Committee was enthused with the potential for coordination and synergy between these energy research areas and the appointment of National Academy member Professor Reifsnider to direct the overall effort.

The CoEE will focus on the design, development and analysis of advanced materials that will be required to extend the life of existing nuclear power reactors and for the next generation of more efficient reactors. South Carolina is already a national leader in generating 55% of its electricity via nuclear power reactors. It is, therefore, sensible that USC become a leader in researching new technology reactors and nuclear fuels, including issues with the full life cycle of radioactive materials.

As part of this proposal and USC's growing academic credentials in nuclear engineering, the University has committed substantial resources in developing the educational component of this program. Unfortunately, many universities across the U.S. dismantled their nuclear engineering programs in the 1980's and 1990's leaving the country with an aged population of researchers and few students studying this field. USC has grown a graduate program in nuclear engineering with 12 recent Ph.D. graduates and dozens of M.S. candidates. The endowed chair recruited for the CoEE will further enhance the academic program as well as the basic and applied research efforts.

The proposers have organized an impressive collaboration with industry and national laboratories. The Washington Group, Westinghouse and Savannah River National Laboratory, among others, have agreed to partner on this proposal.

As we understand it, Dr. Khan and the university have nearly completed arrangements for the match of funds for this endowed chair.

Finally, the Committee sees rich opportunities for technology development and transfer from this program. As the nation expands its inevitable commitment to increased nuclear power generation, the industry will need the solutions developed by this CoEE. We view licensing of new technologies and spin-off companies from this research to be reasonably good prospects.

- **WEAKNESSES**

Since the pool of candidates is limited in this area, USC will need to develop extensive contacts and assistance to recruit this endowed chair. It will be challenging, but with the right candidate, this Center has a high probability of success.

The Committee remains somewhat unclear on the probability of basic research funding for the CoEE from the Department of Energy. DOE has devoted relatively little funding to this topic in the last few decades and much of the funding has been awarded to national laboratories such as Oak Ridge. Hopefully, the next Administration in Washington will focus more resources in nuclear energy research via the DOE.

The proposed Nuclear Science CoEE adds further breadth and depth to the impressive cluster of CoEEs related to Future Fuels initiatives at USC. Although the proposal recognizes the important advantages of sharing common facilities and leveraging opportunities with private sector partners, it does not explore how this constellation of CoEEs might be best configured to avoid an "explosion" of small centers that may struggle to reach critical mass, fully seize collaborative opportunities, or exploit efficiencies and economies of scale.

- **RECOMMENDATION**

The external review committee recommends full funding ($3,000,000) for this proposal.

Medical University of South Carolina and Clemson University - Cancer Stem Cell Biology and Therapy
$5,000,000 Requested and Recommended

- **DESCRIPTION**

The Hollings Cancer Center at MUSC and Clemson University, in collaboration with Health Sciences South Carolina (HSSC), propose to establish a Center of Economic Excellence in Cancer Stem Cell Biology and Therapy. With new revelations about the presence and nature of cancer stem cells, the Center would appoint two endowed

professorships ($2M each). One will be a senior translational biomedical scientist and the second will be a biomedical engineering scientist with expertise in tissue engineering. Their goals are to invent new technologies for isolating, growing and manipulating cancer stem cells, as well as normal cells such as bone marrow and organ-based stem cells. This will enable the normal adult stem cells to be engineered for replacement and treatment purposes and will generate further understanding of cancer stem cells and how to eradicate them selectively. The proposal requests $5M from state funds.

- **STRENGTHS**

The principal investigator and collaborators are well qualified to pursue this endeavor: Dr. Kraft is a stem cell and cancer researcher focusing on the prostate. Dr. Gallicchio, project co-leader, has shown the importance of bone marrow stroma (the microenvironment) in replacing leukemia cells with normal stem cells. Another collaborator, Dr. Ogawa has shown that bone marrow stem cells can differentiate to become supporting fibroblasts surrounding tumors in other organs such as lung and prostate.

The proposal and presentation at the site visit demonstrated excellent infrastructure and support: the clinical bone marrow transplant program at MUSC is well established; HCC General Clinical Research Center Stem Cell Expansion Facility has a Class 10,000 clean room designed to support cell therapy research strategies; and collaborator, Dr. Vyavahare, runs the Center of Biomaterials for Tissue Regeneration, a CoEE. The MUSC/HCC Flow Cytometry and Cell Sorting Core is run by yet another collaborator, Dr. Zhou, and houses stem cell biology and cancer researchers (Drs. Peppler and Zeng.) A clinical trials network is in place and tissue bank expansion is planned as part of the project. The program as described would enhance access of CU to clinicians and translational research. It would also expand the HSSC Tissue repository to include a banking system for adult cancer stem cells—technology to be developed—and develop new methods of long term storage of stem cells.

- **WEAKNESSES**

Many others are pursuing cancer stem cell studies. The novel aspects of this program while not in evidence in the proposal were brought out at the site visit. There is no clear pathway outlined for which cancer stem cells will be pursued first and a strategy for starting the research. There was not a clear strategy delineated for how organ-based stem cells would be isolated or manipulated, but the expertise of the team will likely overcome this. Given the infancy of the field, an economically viable product may be further away than expected. The plan for the use of carbon nanotubes in cancer therapies was beginning to be developed, but it was explained that these were only one type of agent planned for testing. While the expertise for improving the laser technology for flow cytometry advances was not in evidence in the proposal, it was demonstrated at the site visit.

- **RECOMMENDATION**

This proposal lays out a plan for building on current strengths in cancer biology and stem cells to explore the new frontier of cancer stem cells. Two endowed chairs, one in tissue engineering and one in biomedical engineering, will collaborate to tackle the problems of understanding the nature of cancer stem cells, identifying their unique characteristics, and exploring methods to eliminate them and not normal adult stem cells. The plan has strong infrastructure support, including instrumentation and expertise, and excellent collaborators in related areas. The panel recommends full funding of these two chairs which should serve to further enhance collaborations between biomedical engineers and cancer researchers and provide a cutting edge program in the new field of cancer stem cell biology and therapy.

The external review committee recommends full funding ($5,000,000) for this proposal.

Medical University of South Carolina - Renal Disease Biomarkers
$5,000,000 Requested and Recommended

- **DESCRIPTION**

This proposal seeks support for two endowed chairs in the creation of a Center of Economic Excellence for Renal Disease Biomarkers. One of the chairs will be an expert in biomarker discovery and the second an expert in translational research. The objective of the COEE is to address the need for reliable and prognostic biomarkers for acute and chronic renal disease. Urine samples will be collected from statewide, practice-based networks and will be examined by proteomic analysis to identify candidate biomarkers. The proposal requests $5 million from the state program and anticipates attracting $2 Million in matching philanthropic funds and $3 million in other eligible MUSC match. Economic development is anticipated through increased sponsored research activity, reduced health care costs and revenue from commercialization. There is considerable potential for intellectual property development and commercialization of newly identified biomarkers for kidney disease.

- **STRENGTHS**

This proposal has many strengths. A compelling rationale for the proposed COEE is presented, in particular, in that it represents an outstanding opportunity to leverage previous investments, e.g., in proteomics, by building critical mass in an area of potential economic development and significant societal impact. The project builds on existing strength at MUSC in proteomics, especially through an NIH-funded Proteomics Center and two proteomics-related COEE's.

The proposed creation of the MUSCRATS network and the BiomarkSC network represents a clever and novel approach with a good chance of being effective for sample collection and clinical trials. This medical practice-based research network should be effective in collecting samples using standardized protocols and should permit the collection of sufficient number of samples to yield meaningful information on kidney disease progression and predicted outcome. The lead investigators clearly have sufficient

experience and expertise to design the study for optimal results. The results have the potential to significantly impact clinical practice and health in South Carolina and elsewhere. The estimate of revenue generation is aggressive but realistic.

WEAKNESSES:

The proposal would benefit from a clearer description of the population from whom samples will be collected and the likelihood of collecting and storing the necessary number of samples, i.e., the logistics of the proposed approach. This concern is not major in light of the analysis performed by the lead investigators on the needs for sample collection.

RECOMMENDATION:

This is an outstanding proposal that addresses a widespread and important health problem in South Carolina and elsewhere. The plan for implementation is sound, clearly articulated and well justified. The program would leverage and integrate with existing COEE's, thus building capacity and critical mass. The potential is high for positive impact on health and economy in South Carolina.

The panel recommends full funding ($5,000,000) for two endowed chairs as requested.

Medical University of South Carolina / University of South Carolina / Clemson University - Advanced Tissue Biofabrication Center
$5 Million Requested and Recommended

- **DESCRIPTION**

This proposal requests funding for three endowed professorships (one each at MUSC, USC and CU) in various aspects of tissue biofabrication as the foundation for a South Carolina Center of Economic Excellence (CoEE). The Center will focus on collaborative and multidisciplinary studies coupling computational and development biology and bioengineering with a specific focus on vascular regeneration as a basis for tissue generation.

- **STRENGTHS**

The state of South Carolina has a promising opportunity to provide national leadership in tissue biofabrication by building on existing strengths in regenerative medicine through expansion of the infrastructure to create bioartifical vascular networks. The long-term vision involves industrial scale production of complex tissues and organs for diagnostic and therapeutic applications.

This proposal is a timely and important addition to MUSC's evolving strengths in the CoEE research cluster related to cardiovascular bioscience and medicine. When combined with the recently created MUSC endowed chairs in proteomics and regenerative medicine, as well as the South Carolina Bioengineering Alliance, South Carolina is well positioned to make major contributions in the basic science and technology of *in vitro* tissue engineering.

The proposal documents a well-crafted fundamental and innovative approach to advance biofabrication, specifically addressing the challenge of engineering a branched human vascular tree. The project focuses on computer-aided deposition of hydrogels and living cells as a one-step approach, in contrast to the more traditional two-step approach involving formation of a solid scaffold followed by cell seeding in a bioreactor.

Steps involved in the proposed regimen include direct differentiation of stem cells, biofabrication of vascular tissue spheroids, bioprinting of branched vascular networks, and accelerating tissue maturation. There are many scientific and practical challenges remaining to be addressed, but proof of concept already has been demonstrated for many of these steps. The most severe challenge will be to demonstrate the ability to move through the full sequence from "blueprint" to "bioreactor" to produce mature and functional vascular segments.

The concept of cell printing is not novel, but the proposed functional implementation constitutes a new approach. Although there are competing biomanufacturing programs at premier institutions such as Stanford and the University of Michigan, none apparently are targeting the fabrication of vascular systems. The proposed CoEE should further expand opportunities to attract federal agency support, notably from NIH and NSF. For example, funding for an NSF Research Infrastructure Improvement Grant is anticipated in the near future. There are many promising research directions to pursue over the next decade, irrespective of the ultimate outcomes of particular approaches to biofabrication.

- **WEAKNESSES**

The major limitation of the proposal is that the cycle from basic research to practical applications for tissue biofabrication will likely be a lengthy one and one of high risk. Addressing the vascular network is only one of the many challenges in producing commercial products supporting bioengineered tissues and organs. Despite the long timeline relative to the customary expectations for CoEE initiatives, the strength of the research program offers the promise of substantive results of economic and social value to South Carolina and beyond over the course of the next decade.

To help offset the concerns about short-term impacts, the CoEE should consider the possibility of applications arising from the early work on vascular generation that may be used to produce improved stents and vascular implants. In addition, some additional focus would be useful on development of an infrastructure to fully support successful product launches as the research and discovery phase continues. The opportunities for obtaining the private match and industry engagement are significant, but not very well established in the proposal. It is important to construct a targeted strategy to develop substantive and economically impactful industry partnerships

- **RECOMMENDATION**

The external review committee recommends full state funding ($5,000,000) as requested for this proposal.

CATEGORY 2 - MERITORIOUS, BUT WITH NEED FOR IMPROVEMENT AND RE-REVIEW BEFORE RECOMMENDATION FOR FUNDING

Medical University of South Carolina / University of South Carolina / South Carolina State University - Cancer Disparities Research
$5,000,000 Requested; Revision and Resubmission for Two Chairs (excluding Chair in Biomarkers) Recommended; Amount TBD

- **DESCRIPTION**

This proposal seeks support for three endowed chairs in the creation of a Center of Economic Excellence in Cancer Disparities Research. The objective of the COEE is to achieve a reduction in prostate cancer incidence, particularly in African Americans, through the development of new biomarkers, the control of obesity, the development of screening and interventions directed at underserved populations, and the training of a new generation of prostate cancer researchers in the State. The proposal is led by MUSC in collaboration with South Carolina State University and University of South Carolina. The proposal requests $5 million from the state program. However, neither the budget nor the anticipated match is described in sufficient detail to be evaluated. Economic development is anticipated from a decrease in health care costs in the state from reduced prostate cancer and from the development and marketing of new prostate cancer biomarkers.

- **STRENGTHS**

The proposal addresses two important and compelling health problems, prostate cancer and obesity, which occur with a high frequency overall in South Carolina and disproportionately affect African Americans. The project is designed to test the novel hypothesis that obesity is linked to prostate cancer. While the hypothesis lacks strong support from the literature, the study population in South Carolina is ideally suited and is accessible through established clinical trials networks. Of particular note is the 36-county infrastructure developed by SCSU for conducting clinical trials. There is evident strength in health disparities research at all three participating campuses (MUSC, SCSU, USC), with particular strength at the lead institution (MUSC) in epidemiology and bioinformatics as well as cancer research and biomarker discovery. The engagement of a representative of the Historically Black Colleges and Universities (HBCU) in this strongly collaborative proposal is very appealing. Strong institutional commitments to the program appear to be in place in the form of matching support.

- **WEAKNESSES**

A number of significant concerns were identified by the panel, primarily related to two issues: (1) the nature of the link between obesity and prostate cancer, and (2) the likelihood that a new prostate cancer biomarker will be identified in the timeframe proposed. While obesity is strongly linked to many disease conditions, the link to prostate cancer is tenuous and controversial in the literature. The rationale of the proposal is thereby weakened, although the importance of obesity reduction to improved health is clear. In the panel's view, the project would be well served by including a focus

on behavioral and psychosocial interventions for obesity as well as the analysis of chemical intervention as described in the proposal. In the professional opinion of the review panel, it is highly unlikely that a new biomarker for prostate cancer will be identified in the near term, considering that such a marker has been sought intensely for many years by research universities and private sector industry. No clear strategy was delineated that would give the proposed COEE an advantage. For this reason, the panel does not support the recruitment of the Endowed Chair designated to have expertise in cancer biomarkers. Indeed, in the panel's view, the project would be strengthened by concentrating on chemical and behavioral obesity intervention and its impact on cancer among other health conditions likely to be affected. Considering the potential impact of this research direction, the panel would support the recruitment of the proposed Endowed Chairs in nutritional epidemiology if the proposal were appropriately revised to reflect an emphasis on this aim.

An additional issue identified by the panel was the very sketchy budget that needs to be amplified to provide sufficient detail for evaluation. Similarly, the anticipated source(s) of matching funds should be clarified, as should the anticipated academic homes of the proposed endowed chairs. These issues should be addressed and clarified in a revised application.

- **RECOMMENDATION**

The strengths of this proposal include the potential to address a major health problem in African Americans and a significant health disparity, the engagement of multiple universities including an HBCU in true collaboration, strength in health disparities research at all three participating institutions, and a study population that is ideal for the proposed questions, perhaps uniquely so. The plan to reduce obesity in the African American population represents an important research opportunity and could have a major positive health impact. Despite these strengths, the proposal has several significant weaknesses. On the basis of the panel's substantive concerns about the proposal as written, it is recommended that the proposal be revised to emphasize a focus on obesity reduction through chemical and behavioral mechanisms and, correspondingly, to request (at least) the two Endowed Chairs in nutritional epidemiology to support that effort. Support of the Endowed Chair in cancer biomarkers is not recommended. The panel strongly encourages interaction with the physical fitness and well-being programs associated with the Arnold School of Public Health at USC, and with the COEE in Molecular Nutrition at Clemson. The revised proposal should also clarify the questions about budget, matching funds, and proposed locations for the endowed chairs.

Medical University of South Carolina / University of South Carolina - Center for Medication Safety and Efficacy
$5,000,000 Requested; Revision and Resubmission for One Chair for $2,000,000 Recommended

- **DESCRIPTION**

The focus of this application is upon understanding and preventing adverse drug effects (ADEs). In particular, emphasis will be placed upon at risk populations, e.g., the elderly and children. There are many potential causes for drug errors including mistakes by healthcare professionals and pharmaceutical companies. ADEs are known to have considerable health and financial consequences including increasing hospital stays. It is estimated that as much as $5.6 million in additional costs per hospital/per year result from ADEs. Clearly, reducing ADEs would have considerable economic impact.

- **STRENGTHS**

A major strength of this proposal is the infrastructure already in place for support of the proposed chair in pharmacoeconomics or pharmacoepidemiology. The proposed partnership between HSSC, MUSC and USC provides considerable expertise for focus on pharmacoeconomics and pharmacoepidemiology. Moreover, participation of the Arnold School of Public Health at USC and the joint Pharmacy program provides clear evidence of expertise needed in pharmacoeconomics and pharmacoepidemiology which would be supplemented by an Endowed Chair. It is also clear that finding matching funds for this support is likely. In addition, the established network of hospitals in South Carolina should ensure a sufficient database for examining both the frequency of ADEs as well as the cause for the medication errors. There is also strength in this proposal provided by the expertise of the principal investigators who crafted this application.

- **WEAKNESSES**

Several weaknesses exist which reduce the enthusiasm of the Review Panel for this proposal. First, it is not clear that there is the infrastructure necessary to support an Endowed Chair in Pharmacogenomics. As indicated in the presentation, there is at present only a small group in place. Moreover, this area of investigation will require considerable expertise and financial resources to identify the mechanisms of action of ADEs, neither of which appears to be abundant. There are a number of efforts underway in other states which are considerably ahead of the efforts in South Carolina. A second concern was the lesser involvement of the Schools of Medicine in the pharmacogenomics aspects of this application. In order for this part of the proposal to succeed, there should be an enhanced effort to involve SOM faculty at MUSC and USC. A final concern is that the economic impact of these efforts in creating new jobs for the State of South Carolina is not clear.

- **RECOMMENDATION**

The Review Panel did see considerable merit in the proposed Chair in pharmacoeconomics/pharmacoepidemiology due to the strength of faculty at the Arnold School of Public Health and the School of Pharmacy. Moreover, there is no doubt that ADEs are responsible for considerable unnecessary expenditures. Thus, creation of a

Center for Medication Safety and Efficacy is a very good idea. However, there was not, at present, enthusiasm for the proposed Chair in pharmacogenomics. The Panel recommends funding for the Chair in pharmacoeconomics/pharmacoepidemiology if the proposal is revised to refocus the application.

Thus, partial support is recommended for the Chair in pharmaeconomics/ pharmacoepidemiology.

CATEGORY 3- NOT RECOMMENDED FOR FUNDING AT THIS TIME

The Review Panel does not consider the following proposals to be appropriate for funding at this time:

University of South Carolina / Medical University of South Carolina - Translational Biosciences Research
$5,000,000 Requested; not Recommended for Funding at this time

- **DESCRIPTION**

This proposal describes the creation of a Translational Biosciences Research Institute. It will be led by a new endowed chair holder and is a collaboration among USC, MUSC, the SC College of Pharmacy, and surrounding hospitals. A vertically integrated Contract Research Organization (described as somewhat distinct from a standard CRO) is envisioned which will contain facilities, personnel, equipment and other infrastructure. These various components will serve to accelerate the identification of active small molecule and biologic compounds, and their process development under good manufacturing practice. Likewise, the process of pharmacological and toxicological testing, investigational new drug applications and clinical trials will be accelerated. The planned location of this university-based clinical research organization is the Innovista research campus at USC. The request is for $5 million for the endowed chair and salaries for junior faculty and technical support as well as specialized instrumentation. Matching funds will consist of an additional $2 million for the endowment and $3 million for equipment and start-up expenses and the first year of the chair holder's salary.

- **STRENGTHS**

There is a significant demand for this type of activity and few institutions are engaged in trying to provide it. The concentration of activities in a single place and organization should lead to improvements in efficiency and accuracy of drug development. The opportunity for careful, accurate and expedited evaluation of potentially active small molecules and biologics will ensure that novel agents will either be sent forward or quickly eliminated from further consideration. The plan builds on existing facilities and expertise in the SC system with excellent collaborators from differing and synergistic areas on board, including CoEE for Cancer Drug Discovery and Translational Cancer Therapeutics. The Drug Discovery Core led by Dr. Charles Smith is an important part of this network and includes computational chemistry expertise.

- **WEAKNESSES**

The identification, recruitment and retention of the right chair holder in the formative years of the program are critical and success is far from assured. The first individual identified for the chair has agreed to be a consultant but will not assume the chair. Financial rewards other than increased grant activity are likely to be further out than 3-5 years. A focus on a few disease(s) was suggested, but the argument was made that this was not needed. Still, testing for all things and all circumstances seems unrealistic.

The value-added nature of this CRO as distinct from a "fee for service" activity was not fully demonstrated.

A clear plan for including training opportunities for graduate and postdoctoral fellows was absent. It was noted that trainees could be involved with a specific phase of drug development but would not see the process through.

The most important unresolved issue is the fact that costs for setting up the operation (build out of space, salaries and start-up costs, animal facilities) are very large as the proposed budget and additional information provided in answers to the submitted questions demonstrated. No fundraising has begun although MUSC would initially "advance as much as $2.1 million for faculty salaries and start-up."

- **RECOMMENDATION**

This proposal has some strengths and the concept of a university-based CRO with strong vertical integration should affect an increased efficiency and accelerated pathway to drug development. However, the high costs of the initial build out and set up for the operation are large and fundraising has not begun. The recruitment of the right individual to head the operation is key and not far along. More time to develop the plan, begin fundraising and identify strong candidates for the leadership position is needed. The panel felt the program could reapply for consideration at a later time.

Clemson University / University of South Carolina / Medical University of South Carolina - Health Facilities Design and Testing (Phase II)
$5 million Requested; not Recommended for Funding at this time

- **DESCRIPTION**

The proposed Center for Health Facilities and Design Testing (CHFDT) will direct its efforts at examining how the design of health facilities and equipment impacts the operational efficiency, therapeutic outcomes, safety/satisfaction of patient and staff and the environment. Through the recruitment of researchers and creation of prototyping laboratories, CHFDT plans to conceive, test and bring to market new design concepts and products for a broad range of healthcare spaces.

Two chairs were approved for this center last fiscal year (Clemson - Healthcare Architecture and MUSC - Human Factors Medical Research), and two additional chairs are requested in this Phase II proposal. In Phase II, a new Clemson chair will be

recruited in the area of Industrial Design of Related Medical Equipment and a USC chair will focus on research related to how features of the built environment impact indoor environmental quality and infection control.

- **STRENGTHS**

The creation of this center offers South Carolina a unique opportunity to become a leader in this emerging field of study. A strong interdisciplinary approach to testing the interaction of people, equipment, and facilities should assure outcomes that can be quickly adopted by healthcare designers/providers. Given the demand for new facilities and competition in the healthcare arena, this research should find an eager market. The center already intends to tie Clemson and MUSC programs together, and with the addition of two new chairs (a second Clemson chair and a first USC chair), USC would also join this multi-institutional program. Clemson is intended to be the lead fiscal agent for this award. The novelty of this program is one of its greatest strengths.

Strong industry support for this program was clearly demonstrated during the onsite review. Local providers and users of this information lent their support for the creation of CHDFT. Eager support was also demonstrated for David Allison as Project Director. Mr. Allison is the Director of Graduate Studies in Architecture and Health as well as Professor in the School of Architecture at Clemson University. He has a good track record of securing funding in this space and a strong publication record. His enthusiasm and commitment to the success of the CHDFT was readily recognizable by the external review committee.

- **WEAKNESSES**

The primary weakness for this project is the fact that neither chairs approved last year has been filled. Having these chairs filled would lend strength to proposal by creating a more compelling need for the current request. It was difficult for the external review committee to appreciate all the potential synergies of four endowed chairs and three institutions given the center's current stage of development.

As with most academic programs, publication and the training of students provide the primary outlets for new knowledge. The CoEE program has been designed to award programs that stimulate economic growth. The CHFDT will certainly contribute to the dissemination of new knowledge in this emerging area of study as well as to help assure a steady flow of graduates to support a growing industry. There is also some evidence that the existence of this center could provide an additional boost to South Carolina's economy by encouraging the clustering of new businesses around the center's activities.

The external review committee feels that another weakness of this proposal is the potential to drive additional revenue/job creation through the deployment of new intellectual properties. Much of the research appears to be focused around the combination of equipment, people, and facilities. While it is certainly possible that this research will lead to patentable discoveries, the design nature of this work would appear to us to be less likely to generate patentable subject matter than other projects.

- **RECOMMENDATION**

The external review committee recommends that no funding be provided at this time. We encourage the submission of another proposal after recruitment of two chairs approved last fiscal year. Having the first two chairs in place will document sufficient interest in this emerging space and better allow the applicants to demonstrate the synergies of a multi-institutional program that will support job creation across the state.

SUMMARY OF 2007-2008 COEE ONSITE REVIEW PANEL AWARD RECOMMENDATIONS

Category One Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
Optoelectronics	1			$2,000,000
Cyber-Institute	1			$2,000,000
Advanced Tissue Biofabrication	1	1	1	$5,000,000
Cancer Stem Cell		2		$5,000,000
Renal Disease Biomarker		2		$5,000,000
Nanoenvironmental Research & Risk Assessment			1	$3,000,000
Nuclear Science and Energy			1	$3,000,000
TOTAL	**3**	**5**	**3**	**$25,000,000**

Category Two Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
Cancer Disparities			TBD	TBD
Medication Safety and Efficacy			TBD	TBD

Category Three Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
Translational BioSciences Research				—
Health Facilities Design & Testing				—

Part Five: Conclusion

As noted in previous reports, the Site Review Panel believes that South Carolina has an exceptionally strong program in the Centers of Economic Excellence. There is no question that the investments made in the previously and currently recommended programs are beginning to yield extraordinary benefit for South Carolina.

Despite the great strengths of this program, South Carolina cannot assume that current achievements will assure competitiveness. The competition to be a leader in the knowledge economy is getting tougher, as more and more states and nations appreciate the need to rethink their educational and research structures. The race will not end any time soon, and it would be a disaster for South Carolina to pause, much less drop this program just as others are beginning to consider similar strategies. South Carolina needs to continue its bold, but also balanced and prudent investments in the knowledge economy.

The Onsite Review Panel strongly believes that this program should be continued and strong consideration should be given to creating new funding for aid to the universities in offering competitive startup packages to the endowed professors recruited. In addition, there is considerable need for pre-seed funding for startup companies being formed out of the CoEEs. Finally, consideration should be given for funding to enhance technology transfer on all campuses as well as shared infrastructure to enhance the movement of intellectual property out of the universities.

This is an outstanding program which demonstrates the enlightened thinking of State and University leaders. It is attracting national attention and will produce new ideas resulting in the creation of new, high quality jobs for the citizens of South Carolina.

South Carolina Centers of Economic Excellence
Review Panel Report

June 8, 2009

The Onsite Review Panel met in Columbia, South Carolina on May 4-6 for review of proposals submitted by Clemson University, the Medical University of South Carolina, and the University of South Carolina. During this visit the Review Panel heard presentations from individuals at each campus who had submitted proposals to the South Carolina Centers of Economic Excellence (CoEE) Review Board as well as from senior leadership of each campus. Following Review Panel deliberation both in person, via telephone, and email, the merits of each proposal were assessed.

This document presents the findings and recommendations of the Review Panel and is organized as follows: **Part One** provides an overview of the CoEE Program; **Part Two** provides general findings and recommendations from the Review Panel; **Part Three** offers suggestions for improving program operation including suggestions for additional funding and infrastructure needed to support the CoEE Program; **Part Four** describes the Review Panel's recommendations for funding based on its review of the 2008-2009 proposals; and **Part Five** offers a summary conclusion from the Review Panel.

Part One: Program Overview

Program Description and History. In 2002, the South Carolina General Assembly enacted the South Carolina Research Centers of Economic Excellence (RCEE) Act. The legislation originally designated $200 million through 2010 from the South Carolina Education Lottery to establish Centers of Economic Excellence by creating unique endowed professorships at South Carolina's three senior research institutions: Clemson University, the University of South Carolina, and the Medical University of South Carolina. In 2008, the S.C. General Assembly revised the RCEE Act to provide for $30 million in guaranteed funding each year provided all lottery scholarships have been funded, and provided at least 80% of all appropriations have been awarded through the most recent previous fiscal year.

Awards are made through a competitive application process which encourages collaboration among the three research institutions and with other higher education institutions in the state. Funding decisions are made by an 11-member Review Board appointed by the Governor (3 appointees), the President Pro Tempore of the Senate (3 appointees), the Speaker of the House of Representatives (3 appointees), the Chair of the Senate Finance Committee (1 appointee), and the Chair of the House Ways & Means Committee (1 appointee). The CoEE Review approves new CoEEs and provides program oversight. The three research university presidents serve as ex-officio, non-voting members of the Review Board. (Staff and operational support for the CoEE program are provided by the Commission on Higher Education, which also approves the program annual operating budget.)

Current Program Status. The program is currently in its seventh year of soliciting and reviewing proposals from the state's three research universities. This year 8 proposals were submitted to the Review Panel for evaluation.

Over the last six years the Review Board has approved funding for 42 research proposals from USC (11), MUSC (17), and Clemson University (14) and their partner-institutions, totaling $172.6 million in state lottery funds. To date, over $91 million in lottery funds have been drawn down and distributed to the institutions, and the institutions report just over $142 million in matching fund pledges, of which just under $100 million has been received.

The 42 approved CoEEs represent a diverse palate of research fields. A complete list of the funded centers is appended to this report (Appendix A). A number of Centers also represent collaborative efforts among the state's three research universities.

The 2008-2009 funding cycle included 6 individual and 2 collaborative proposals:

Institution(s)	**Project Title**	**Amount Requested**	**Chairs**
Clemson	Tissue Systems	$3.1 million	1
Clemson	Sustainable Development	$4 million	1
MUSC	Arthritis and Connective Tissue	$5 million	2
MUSC	Clinical-Translational	$5 million	1
MUSC	Lipidomics	$5 million	2
MUSC /USC	Brain Digestive Diseases	$5 million	2 (1 MUSC, 1 USC)
USC	Nuclear Science	$3 million	1
USC/MUSC	Healthy Lifestyles	$5 million	2 (1 USC, 1 MUSC)
TOTALS	**8 Proposals**	**$35.1 million**	**12**
	Available 2008-09 funding	**$19.4 million ***	

* $12 million of accrued interest from the Centers of Excellence Matching Endowment, plus $5.4 million in 2007-2008 rollover funding, plus $2 million from the withdrawal of the Molecular Nutrition CoEE.

Evaluating the Proposals. The process of assessing the quality and viability of each proposal proceeded in several phases. **The first phase** involved submitting the proposals via email to external reviewers coordinated by the American Association for the Advancement of Science (AAAS) to determine the technical and scientific merit of each research project. AAAS provided consensus reviews based upon input from several reviewers. Reviewers were asked to assign points to the proposal in each of four categories: Scientific and Technical Merit (up to 40 points); Approach, Process, and Execution (up to 25 points); Innovation (up to 25 points); and Infrastructure, Support, and Collaboration (up to 10 points). The maximum point total is 100. This was the first year the CoEE program contracted with AAAS, and the institutions seem to feel that this change is a positive step, including the development of a composite review. In addition, at the request of CHE staff, a specific holistic question was added for the technical reviewers to help address each proposal's economic impact: "Assess the potential for the targeted research to lead to economic development and the creation of well-paying jobs for the people of South Carolina."

The second phase involved the Onsite Review Panel. Each proposal was assigned a lead reviewer and a secondary reviewer from the Review Panel. The role of the lead reviewer was fourfold: (1) to write questions to the principal investigator about the proposal for submission prior to the visit; (2) to serve as the effective chair of the Review Panel for that proposal, including taking the lead in formulating questions; (3) to lead the Review Panel's internal discussion and ranking of the proposal during deliberations; and (4) to draft the narrative section required for the final report. The secondary reviewer provided reinforcement and support for the lead reviewer assigned to each proposal. In addition, the secondary reviewer wrote pre-site visit questions and led questions regarding economic impact during the site visit.

At the conclusion of each day's presentations, the Review Panel convened to discuss the proposals and began drafting a preliminary report. Finally, during subsequent weeks, under the guidance and direction of Review Panel Chair Waldrop, the Review Panel communicated via telephone and email to arrive at final conclusions and funding recommendations. The 2008-2009 Review Panel included the following evaluators:

Name	Title	Institution
Richard Linton, Ph.D.*	Vice President for Research & Graduate Studies	University of Oregon
Maria Pellegrini, Ph.D. *	Former Vice President for Research Executive Director of Programs	Brandeis University W.M. Keck Foundation
James Roberts, Ph.D.*	Former Vice Provost for Research	University of Kansas
Todd Sherer, Ph.D. *	Assoc. Vice President for Research & Director of Technology Transfer	Emory University
James Siedow, Ph.D.	Vice Provost for Research	Duke University
Tony G. Waldrop, Ph.D. * Chair, Review Panel	Vice Chancellor for Research and Economic Development	University of North Carolina at Chapel Hill

* Returning Review Panel Members

Part Two: General Findings and Recommendations

The 2009 CoEE Onsite Review Panel visited Columbia on May 4-6, 2009, to hear presentations from Clemson University, the University of South Carolina, and the Medical University of South Carolina. As usual, the staff of the South Carolina Commission on Higher Education provided exemplary support. In addition, the participating universities and the collaborating organizations ensured an environment which was well-organized and highly informative. Taken together with the extensive documentation provided in advance, the Review Panel believes it had access to sufficient information to make recommendations for funding. Those recommendations are provided in detail in Part Four of this report.

This year, increased emphasis was placed on evaluating the potential economic impact of the proposed programs. One reviewer was asked specifically to examine the proposed economic impact and to provide questions both in advance and during the site visit in order to probe the short and long-term economic potential. In addition, John (Jack) W. Ellenberg, Deputy Secretary for New Investment at the South Carolina Department of Commerce, served as a non-voting consultant to the Review Panel. He provided exceptional input and provided useful economic perspective for the reviewers.

The extensive documentation on the CoEE Program, together with the opportunity to interact with university personnel and representatives of affiliated organizations, also provided the Review Panel with an opportunity to comment on the overall purpose, structure, and foundations of the program. The Review Panel was very impressed with the openness of senior institutional leadership in answering questions.

Success of the S.C. Centers of Economic Excellence Program

As noted in last year's report, the Review Panel is very impressed with progress that is being made in attracting high quality faculty as CoEE Endowed Chairs. It is very evident that strong progress is being made in reaching the intended goals of this program related to economic development. Already, many outstanding endowed professors and junior faculty have been recruited to South Carolina and have brought in grants totaling well over $120 million. Grant funding by itself leads to an economic impact.

In addition, a number of start-up companies have been formed from CoEEs. These include FirstString, which markets wound repair technology, and Cephos Corporation, which is involved in brain imaging technology. It should also be noted that the presence of CoEEs has attracted existing companies to establish a presence in South Carolina. Examples include the Timken Company, BMW and Michelin which have all located corporate teams and offices at the Clemson University International Center for Automotive Research (CU-ICAR). It is estimated that more 800 jobs have resulted from the relocations at CU-ICAR.

The CoEE Program has had several impacts that are not directly economic in nature but downstream will lead to extraordinary effects on the economy of South Carolina. There is exceptional collaboration taking place among the three research universities that was

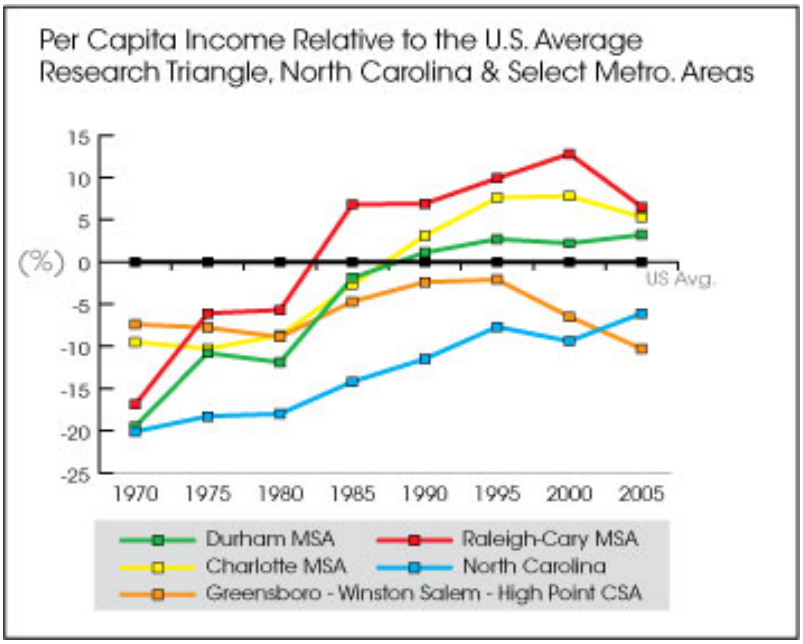
weak prior to the establishment of this program. The joint S.C. School of Pharmacy (USC & MUSC) is a prime example of this cooperation. Other examples of CoEE-induced changes include Health Sciences South Carolina (HSSC), the clinical trials networks formed, and the eIRB that has been established. Bringing research faculty, clinicians, and the corporate sector closer together throughout South Carolina has provided a rich environment for the creation of new research programs, new clinical treatments, and partnerships which can result in spin-off companies as well as improvement in the quality of life for all South Carolina citizens. The National Association of State Universities and Land Grant Colleges has provided information about the economic impact of state funding provided to universities [See sidebar.] These effects are very much at play in South Carolina.

The Economic Impact of Public Universities

NASULGC Survey 2001

- *The average return on every $1 of state money invested in a public university is $5.*
- *For every $100 spent directly by a public university, its employees , visitors, and students spent $138 of their own funds.*
- *For every job on a public university campus, another 1.6 jobs are generated beyond the campus.*

It should be noted that efforts such as the CoEE Program take time to reap overwhelming rewards in job creation. For example, Centennial Campus at North Carolina State University and Research Triangle Park (RTP) took at least 15 years to exert a significant impact on the economy of the region and the State of North Carolina. As shown below, the RTP area (Durham and Raleigh areas) grew from below the national per capital income to above the national level following RTP development. The success of both these programs depended in no small part on enlightened leadership which understood the need for initial investment for long-term payoff.



The Review Panel is very aware of the severe economic situation in South Carolina as well as throughout the nation. We believe with utmost enthusiasm that this program should be continued. However, it should be noted that no new funding was provided in FY 08 and FY 09, so it is critically important to sustain the momentum of this exceptional program by providing funding in FY 10. As noted above, it is very clear that much of the basic foundation has been created to spur economic development in the State. Continued investment will evoke considerable returns on these initial efforts that have created a core infrastructure.

Part Three: Suggestions on Improving Program Operation

The Review Panel has been very impressed with the structure and operation of the Centers of Economic Excellence Program. However, the Site Review Panel continues to have ideas about how the CoEE program could be improved, and provides the following thoughts on a variety of topics.

Up-Front Funding

The Review Panel notes that only 22 of the 75 (29%) authorized endowed chairs have been filled. It should be noted that the endowed chairs who have been hired and those who are being recruited are of a high caliber. As highlighted in last year's Review Panel report, there are considerable costs associated with recruiting world-class faculty as Endowed Chairs. The research universities are now investing $2-$3 million to be expended over a period of 1-3 years for recruitment of a new faculty member. Recruitment costs include salaries for junior faculty, postdoctoral trainees, any students and staff who will accompany the Endowed Chair to South Carolina as well as specialized equipment and laboratory renovation.

These costs along with the current severe economic climate have placed great constraints on the financial capability of the research institutions. Even before the latest economic situation, the institutions were having difficulties filling the endowed professor positions that were authorized. This was due to the up-front costs described above. The Review Panel is very concerned that the universities will have great difficulty, in the current climate, in finding the resources for the required match and for the up-front costs . We recommend that the State consider using some of the accrued interest in the CoEE program to provide assistance with the direct costs needs in support of faculty recruited to endowed chairs. In addition, funding is needed to support the recruitment process of the endowed chairs.

Proliferation of Centers

As the CoEE Program has developed, a rich infrastructure has been developed with a considerable number of centers. The Review Panel believes strongly that a new center does not have to be created for each proposal area. We recommend that the institutions consider adding new endowed chairs to existing "umbrella" centers where appropriate. This approach has several advantages. First, it would reduce the infrastructure costs (staff, general operation funds, etc.) needed for running each center. It will also ensure close interactions between or among chairs who are focused in a particular area of

research, increasing the likelihood of disclosures of new inventions. Increasing the number of distinguished professors in one unit rather than in several will enhance the national profile of the center. This will make it easier to recruit additional outstanding faculty as well as to generate external funding.

The university leadership seem to be under the impression that this approach is not permissible, although the Program *Guidelines* clearly allow for it. Staff has already transmitted a letter (see Appendix B) to correct this misperception and to direct attention to the relevant section of the Program *Guidelines*.

Promotion and Tenure

This issue was raised last year and it was not stated at the site visit if any changes had been made. The text below was in last year's report and still needs to be addressed if significant progress has not been made:

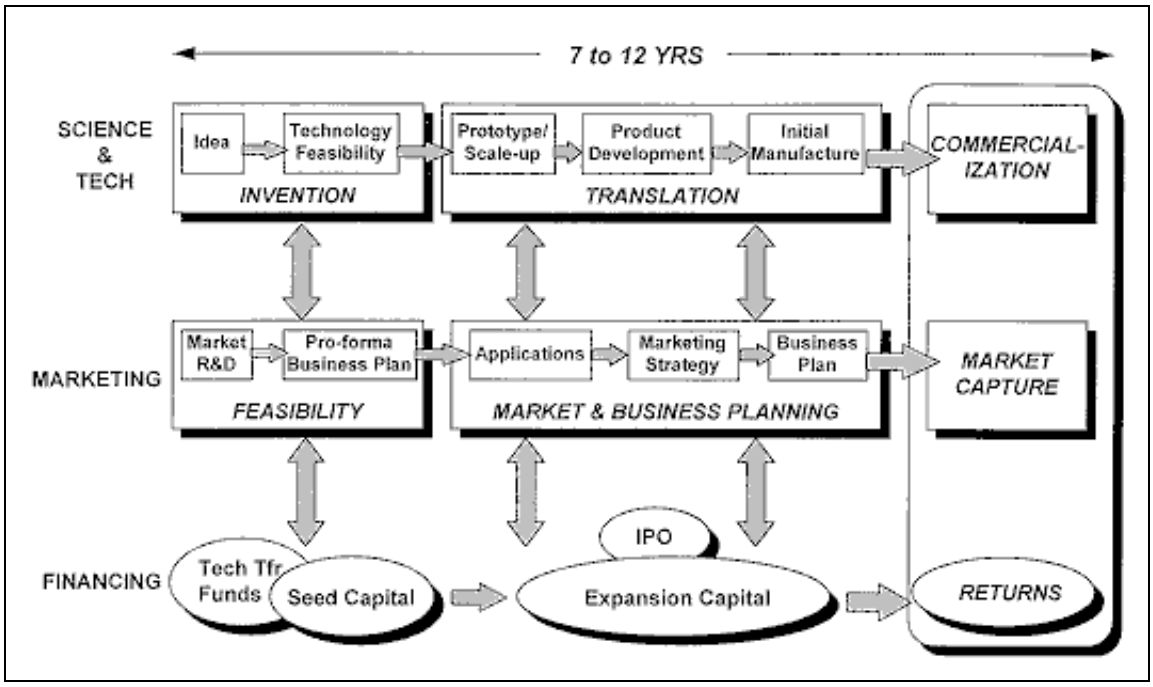
> The research universities in South Carolina should be encouraged to develop policies and procedures that reward success in technology transfer in the academic promotion and tenure process. Clearly, not all faculty should be expected to be involved in entrepreneurial activities. However, consideration should be given to those who do participate. Traditionally, the promotion and tenure process awards academic measures of success including peer-reviewed publication and sponsored research awards; however, such measures of technology transfer as patent applications, licensing agreements, and patent impact are frequently not considered. While the Site Review Panel strongly supports the use of traditional academic metrics for promotion and tenure at South Carolina's research universities, acknowledgement of success in technology transfer activities should be considered as well if it is an explicit objective of the state for its academic institutions.
>
> Another area for consideration by the promotion and tenure committee is for acknowledgement of participation in multidisciplinary teams. Many universities are now using this as one criteria considered in evaluation. Again, this should not be required of all faculty but considered for those who have significant impact as part of a team of researchers.

Technology Transfer

It is clear that the CoEE Program has spurred technology transfer efforts at all three universities. There has been a considerable increase in outside funding for research that can be attributed to the creation of the CoEEs. This funding has led to an increase in invention disclosures and patents filed and received.

Since economic impact is the ultimate goal of the Centers of Economic Excellence Program, it is crucial that the infrastructure for supporting institutional technology transfer continues to mature as research grows on the three campuses.

The technology transfer process has a number of critical components which have to function smoothly in order for successful flow to the marketplace. It is exceedingly important that each step of this process be fully developed. Failure to do so will retard or even prevent reaching the ultimate goal of economic impact. The following insert shows that this process includes interactions among the three major components of technology transfer: science and technology; marketing; and financing. Moreover, the impact of this process takes time.



Two critical components needed to support the commercialization of intellectual property derived from the universities are seed funding and venture funding. The latter is well underway with the Venture Capital Investment Act of South Carolina. Pre-seed and seed stage funding also are critical to enable moving intellectual property out of the universities. In their earliest stages of development, startup companies often require relatively small amounts of funding, between $50K and $200K, to complete crucial tasks such as the creation of a business plan or prototype development. The Review Panel has urged South Carolina to consider a specific pool of funding to move ideas across the "valley of death," including the possible creation of innovation funds supported by private investment and tax credit incentives being implemented in other states.

As the infrastructure facilitating commercialized research continues to evolve in South Carolina, the Review Panel urges the Universities and the CoEE Program to consider investing funds to build the appropriate infrastructure necessary to reap the benefits of the outcomes of the research done in the CoEEs. One possibility is that the CoEE Program fund a technology transfer program which could be shared by the three research universities.

As noted in previous Review Panel reports, it is very important that metrics for evaluating the success of transfer of research into commercial products be established. The Review Panel was pleased to receive, in advance of the site visit, a report of several indices of technology transfer. We hope the development of appropriate metrics can be continued and expanded.

The Review Panel is well aware that it typically takes five years or more for successful commercialization of university intellectual property (IP), or in the case of biomedical IP, 10-12 years. In response to its 2006 recommendations, the Review Panel was delighted to see the universities present standard measures (such as invention disclosures, patents filed, patents received, licenses issued, licensing income, start-ups) of technology transfer. Such metrics should continue to be evaluated on a yearly basis and supplied by the three research universities to the Review Panel prior to the site visit, including those used in the Association of University Technology Managers' (AUTM) annual licensing survey. Examination of these indices, especially when they are normalized to the level of research expenditures, will continue to help in the analysis of the success of the Centers of Economic Excellence Program. The CoEE Program is also encouraged to think creatively and to examine best practices in other states to better capture the broader societal impacts of the targeted state investments.

Graduate Education

As in previous years, the Review Panel was quite surprised by the relatively sparse reference to graduate education in the proposals, which is mandated by the Program *Guidelines*. As mentioned earlier, graduate students are very much at the core of successful research-economic development strategies. It is widely accepted among business and higher education leaders that the best form of technology transfer emanates from master's and doctoral graduates. We urge the Universities to consider this in preparing proposals for next year.

Part Four: Recommendations for Funding

The Review Panel has provided three general rankings for the proposals it reviewed:

CATEGORY 1, for immediate funding.

The Review Panel believes that Category 1 proposals are already of high quality, have clearly defined goals and objectives, have most of the key resources for success in place and, if awarded one or more endowed chairs, should find the needed match reasonably quickly and move quickly to success. Proposals in this category are *not* rank-ordered.

CATEGORY 2, meritorious, but with one or more significant failings that could be remedied. Resubmission is encouraged but should require a significantly revised proposal for examination by the Review Panel prior to receiving funding.

Category 2 proposals are similar to those in Category 1 in many ways but require at least one or more significant changes prior to being funded. The Review Panel has tried to

state clearly the change or changes that are needed, but does not believe that funding should be provided without further external review to determine whether the problems have been resolved.

This year, the Review Panel has divided Category 2 into two subdivisions:

> **Category 2A**: Recommended to be revised and submitted in September 2009 for funding out of this year's cycle; and
>
> **Category 2B**: Recommended to be revised and submitted during the 2010 proposal cycle (next year) when they will undergo the entire review process.

CATEGORY 3, having serious or structural flaws. Resubmission is not encouraged without important re-conceptualization and clarification that would be equivalent to a new proposal.

The Review Panel believes that Category 3 proposals require substantial rethinking and would not be recommended funding even if revised. Instead, new proposals could be advanced in the next competition. Proposals in this category are *not* rank-ordered.

Recommendations on the Individual Proposals

CATEGORY 1 - RECOMMENDED FOR IMMEDIATE FUNDING - ($11 MILLION)

The Review Panel did not assign a ranking to proposals within this category.

Nuclear Science Strategies – University of South Carolina
$3 million requested and recommended
Chairs: University of South Carolina (1)

- **DESCRIPTION**

This proposal requests funding for a second endowed professorship in the nuclear energy area. In particular, this proposed CoEE chair and associated new faculty members will focus on interdisciplinary efforts including reducing the cost and schedule of new plant construction through innovations in project management, enhancing the security of nuclear power generation, and addressing the social and policy issues involved.

- **STRENGTHS**

The state of South Carolina has a tremendous opportunity to become the nation's center for nuclear energy, and this CoEE proposal along with the one approved last year can play a key role in making this happen. While not as dramatic as the impact of nuclear energy, if someone today thinks of wine they think of California despite the attempts of other states to foster their own winemaking efforts. And if a student considers enology as a career, they look first to California and in particular to the University of California at Davis. In the same way, if someone thinks nuclear power, South Carolina should work to ensure that they think South Carolina. And if a student thinks of studying nuclear power

and all of its ramifications, then the goal should be to make them automatically think about the University of South Carolina. The latter can only become reality if the two CoEE chairs are filled, the promised supporting faculty members are hired, and USC and the State work to make this happen. Job creation will come as a natural byproduct of South Carolina's becoming the acknowledged leader in nuclear power generation, research, education, and policy.

According to university administration, this proposal grew out of discussions with the local nuclear power industry and the need to help generate a "nuclear economy" in South Carolina. The representatives from industry who attended the site visit presentations were quite supportive and helped make the case for the importance of this proposal.

An impressive feature of the proposal is the desire to incorporate advances in project management with the goal of cutting the time, and consequently the cost, of bringing a nuclear plant on line. Other educational institutions in the State need to be involved in this effort including, where appropriate, historically black colleges and universities and the technical colleges. In particular, workforce development will be critical to this effort. There will be several times the number of skilled nuclear workers needed as compared to nuclear engineers, for example, and all are necessary for success.

In summary, this CoEE proposal will recruit a second chair and other faculty members to work with the South Carolina nuclear industry and the Savannah River National Laboratory facility to create new engineering and technological innovations and methods of project risk management to reduce the cost and schedule of new plant construction, enhance the security of nuclear power generation, address the social and policy issues involved, and educate the next generation of nuclear engineers. If successful, this proposal will have a tremendously positive impact on the economy of the State.

- **WEAKNESSES**

No matching funds have been committed to date for the proposal. However, President Pastides of USC has stated that fundraising for this match is his top priority.

This is a large undertaking, and if done right, will involve many partners. For example, the workforce development issue needs to be more strongly incorporated into the plan for the center. All levels need to be addressed, from maintaining a skilled nuclear workforce to doctoral training for the next generation of university leaders in nuclear energy.

USC should immediately determine if there are funding opportunities in the federal American Recovery and Reinvestment Act (ARRA) for enhancing investment in project management, risk assessment, and/or national security aspects of nuclear power generation. This and other possible collaborations with Savannah River site, for example, cannot wait for the CoEE chairs to be hired. Even though this is not a weakness, it does imply the need for rapid movement in this area.

There is now intense demand for the high-level people who form the pool of candidates for the two CoEE chairs. USC will need to develop extensive contacts and assistance to

recruit this endowed chair, and it will be challenging. The welcoming environment for nuclear energy, the presence of the Savannah River laboratory, and the overall commitment of the State should be used as major attractors for the chairs. If these candidates are found and recruited to USC, the opportunity to establish USC as a, or perhaps the, national leader will be possible. To repeat, it is essential that USC hire the other faculty members committed to the two CoEE's. This is a major effort.

- **ECONOMIC IMPACT**

The economic impact of this proposal was made abundantly clear by the support provided by members of the nuclear industry during the presentation. Nuclear power is a major industry in South Carolina, and job creation will come as a natural byproduct of South Carolina becoming the acknowledged leader in nuclear power generation, research, education, and policy. With 10% of the nation's nuclear power generated within a 150-mile radius of Columbia, and with four new South Carolina nuclear plants under development, there should be a pipeline of major projects for decades to come. The proposed CoEE will be important in improving project management such as policy development and rule making in cooperation with the Nuclear Regulatory Commission, as well as supporting technological improvements, including the development of nuclear power as a heat source for the generation of alternative fuels such as hydrogen. With a critical mass of trained people in the state, new company formation will occur and existing companies should be excited about relocating to South Carolina. Educating the next generation of nuclear experts will ensure that the state can remain a leader and attract talented students to study and stay in South Carolina.

- **RECOMMENDATION**

The external review committee recommends full funding ($3,000,000) for this proposal.

Lipidomics, Pathobiology and Therapy – Medical University of South Carolina
$5,000,000 requested and recommended
Chairs: MUSC (2)

- **DESCRIPTION**

This proposal seeks state support for two endowed chairs ($2.0 million each) and programmatic endowment ($1.0 million) to create a Center of Economic Excellence in Lipidomics, Pathobiology and Therapy. The goal of this center is to leverage MUSC's acknowledged leadership in the area of lipidomics though the acquisition of two new endowed chairs, one in Lipidomics and Pathobiology and the other in Lipidomics and Drug Discovery.

These two new faculty members will fill existing gaps within the expertise currently available to the MUSC Lipidomics group for translation of the basic insights being obtained at MUSC in lipid biology and biochemistry to an understanding of the role of lipids in pathobiology (e.g., cancer and, inflammation and diabetes) and then utilize that information to identify novel targets that will allow the further development of new diagnostics or therapies for use with these diseases. These discoveries will lead to the

development of novel lipid-based compounds for diagnostic purposes, small molecule modulators of lipid metabolizing enzymes, and treatments targeted at a range of lipid-associated diseases. All of these findings will lead to the development of patents that can be licensed, sold, or serve as the basis for developing new start-up companies.

- **STRENGTHS**

The major strength of this proposal resides in the lipid group at MUSC which is widely recognized for its abilities in the study of fundamental lipid biology and biochemistry, particularly in the area of bioactive sphingolipids. The group is large and highly interactive, representing some 36 faculty, 12 of whom are lipid biologists and 24 of whom are collaborating investigators. The group is well-funded, with 28 extramural grants, mostly NIH R01s, but including one NIH Program Project grant (P01) in Sphingolipids in Cancer Biology and Therapy, plus additional grants from the American Heart Association and the Burroughs Welcome Fund. There is also already a start-up company, Sphingogen, associated with this area of study developed by the two PIs. As with other proposals submitted from MUSC this year, an additional strength is associated with the fact that MUSC has received a review score likely to ensure funding of their NIH Clinical and Translational Science Award (CTSA). Funding of the CTSA will provide a vehicle to further help support translation of the results of the basic lipid studies being carried out at MUSC into a better understanding of the role of lipids in any of a number of diseases and onto the eventual development of novel therapeutics for addressing these diseases.

Additionally, recent years have seen enhanced interest in the study of lipids, not strictly as structural (membranes) or storage (fat bodies) elements but rather as key regulators in a number of cell, tissue, and organismal functions, including growth, senescence, cell death, and inflammation. Working with (water-insoluble) lipids has traditionally been difficult, which has often made progress in the field slower than might otherwise be desired. Given the new findings for the role of lipids controlling a variety of biological processes, the lipid group at MUSC is well positioned not only to enhance our understanding of the role of lipids in the regulation and control of many basic biological processes but also to pave the way for translating this understanding into new diagnostic and therapeutic venues associated with pathological conditions involving bioactive lipids.

- **WEAKNESSES**

This is a strong proposal that has no obvious/glaring weaknesses. It is probably worth noting that while the roadmap provided in the proposal, which goes from basic identification of new pathways of lipid metabolism and their role in cellular regulation to development to delivery of new therapies to improved healthcare, is reasonable enough, there are several examples in the proposal where the suggested timeframe from basic discovery to drug or diagnostic delivery seems unrealistically short (e.g., five years). Additionally, there is a goal cited in the proposal that involves establishing two statewide shared facilities, one in synthetic lipid chemistry and another in analytical lipid chemistry to serve the needs of scientists associated with the Center as well as others across the State. Two laboratories that carry out these sorts of analyses already exist within the framework of the lipid group at MUSC, although they do not have the statewide reach or

funding suggested for the two laboratories in the proposal. The proposal does not do a particularly good job of justifying the need for these larger laboratories within the context of the proposed CoEE, and they are not mentioned within the framework of the proposal budget either, although there is mention in the Economic Impact Summary of these two laboratories contributing to economic impact through fee-for-services to other universities and private industry. So, it is not made clear where these two laboratories actually fall within the priorities of the CoEE.

- **ECONOMIC IMPACT**

The most obvious and direct economic impact of this CoEE would be associated with new research funding that would be generated by the new endowed professorships and the existing faculty within the lipid research group. In addition to the $10M associated with the award itself, it is estimated that $12M-$15M in new extramural grant support would accrue to the Center over the first five years of its operation. These numbers seem reasonable when the level of funding accruing to the current group is combined with the knock-on effect expected of bringing in the two visible new endowed professors and other additional faculty.

The likely economic impact of this Center in the commercial sector is harder to judge. The proposal suggests that at least 5-6 patents and two new start-ups would come out of this effort over the first five years. The start-ups would be small, perhaps five technically-trained people per company and little in the way of revenue would be expected initially ($100-150K/yr). Patents could be quite lucrative and be licensed or sold for considerable amounts depending upon their perceived promise, but that won't necessarily directly impact the State of South Carolina.

Independent of the money that might accrue from new commercial ventures, there is also the multiplier effect of the monies being spent on research. Using a multiplier of 2.17 provided in the proposal, another $26M-$33M would be added to the economy as a result of the research activity generated by the lipid group.

- **RECOMMENDATION**

The review panel evaluated this proposal as very strong. The lipid group at MUSC is well positioned already, but the addition of two new faculty with proven expertise in the areas of drug discovery and therapeutic development will add considerably to the group's ability to move the basic discoveries in lipid biochemistry/biology into the translation/commercialization pipeline with much greater facility than currently exists. Funding this proposal should prove to be a boon to the development of biotechnology within the state of South Carolina. The external review committee recommends full funding ($5M) for this proposal.

Tissue System Characterization – Clemson University
$3,100,000 requested; $3,000,000 recommended for funding
Chairs: Clemson (1)

- **DESCRIPTION**

The proposal seeks state support for one endowed chair at Clemson University to create a Center of Economic Excellence in Tissue System Characterization. This chair will be housed in the Institute for Biological Interfaces of Engineering (IBIOE) at Clemson University. The objective of the center is to "expand and connect existing expertise in tissue engineering and biomaterials to build tissue characterization systems as an alternative to animal testing." The presentation further expanded the objectives to include new tissue-based technologies that have the potential to serve as new diagnostic, medical devices, and therapeutic products. The convergence of biology and engineering continues to be a very important focal point for both industry and governmental funding sources. While prominent programs in tissue engineering exist at universities across the country, opportunity exists, and Clemson appears to be building a faculty cluster in this important area.

- **STRENGTHS**

While the proposal was vague as to detail of what was being proposed, the oral presentation was specific and helpful. This is clearly an important area of research both now and for the future. The creation of this center will improve Clemson's opportunity to participate in the ongoing revolution in this space. Promising new medical advances will continue to occur in the juncture between engineering and biology. As a matter of fact, we have likely not even seen the tip of the iceberg with regards to new medical products and diagnostics arising from this interdisciplinary research. IBIOE is an interdisciplinary unit and Dr. Karen Burg is the Director. Dr. Burg has a clear vision for the Institute and is already a very accomplished researcher in the area of absorbable polymers and tissue engineering. Her enthusiasm for this new chair position was evident. Clemson seems to have very strong commitment to interdisciplinary research. Another strength of the proposal was the inclusion of the commercialization process at Clemson. While the process is similar to that of many universities, it demonstrated a commitment from both programs towards the development of new technology and companies in this space. The proposed Center falls within New Carolina's identified Medical Device Cluster which has been identified for the South Carolina Upstate.

- **WEAKNESSES**

The proposal does not adequately address the role of the internal and external IBIOE advisory boards in the direction of the unit. These boards can play an important role in establishing synergy across the unit as interdisciplinary research requires constant commitment. As mentioned previously, the written proposal is vague and was not very helpful in assessing the merits of this proposal. A more detailed written accounting of the opportunity and anticipated outcomes would have been helpful; however, the oral presentation was useful in this regard.

- **ECONOMIC IMPACT**

While the risk for commercializing any new diagnostic, medical device, or therapy is high, so is the payoff potential. This research has substantial potential to create new patentable technology that can be licensed by Clemson to companies which will develop new products for market. These licenses can occur through an established company or through the creation of new ventures. New ventures tend to keep proximity to the university due to their dependence upon the researcher/inventor's laboratory from which the intellectual property was created. These start-ups will help to drive new job creation within the state, and Clemson appears to have made a solid commitment to protecting new inventions and creation of start-ups to deploy its technology. The research conducted by the new chair will also generate sponsored research from industry and will improve the attractiveness of the region to companies considering relocation.

- **RECOMMENDATION**

The reviewers regard this as a timely proposal which would be very complimentary to other efforts underway at Clemson. The creation of the proposed center will help the State of South Carolina achieve the goals of the Centers of Economic Excellence Program. It is strongly recommended that the funding for the Center for Economic Excellence in Tissue Systems Characterization be immediately approved.

CATEGORY 2 - MERITORIOUS, BUT WITH NEED FOR IMPROVEMENT AND FURTHER REVIEW BEFORE RECOMMENDATION FOR FUNDING

CATEGORY 2A: RECOMMENDED TO BE REVISED AND SUBMITTED IN SEPTEMBER 2009 FOR FUNDING OUT OF THIS YEAR'S CYCLE

Technology Center to Enhance Healthful Lifestyles – USC / MUSC
$5,000,000 requested; $2,500,000 recommended for funding
Chairs Requested: USC (1); MUSC (1)
Chairs Currently Recommended for Funding: USC (1)

- **DESCRIPTION**

The proposal seeks state support for one endowed chair at USC ($2.5M) and a second endowed chair at MUSC ($2.5M) to create a Technology Center to Enhance Healthful Lifestyles. The objectives of this proposed CoEE are to "develop, test, and market software and other products for behavioral interventions to improve physical activity, smoking, and dietary habits, and thus promote health and prevent and improve disease outcomes." The applicants note that key milestones from the center will be "marketable software and information systems for internet applications, cell phones, personal digital assistants, iPod technologies and computerized kiosks that have demonstrated effectiveness in reducing health risks." These tools are proposed to have significant impact on chronic diseases and conditions such as cardiovascular disease, diabetes,

cancer, senile dementia, obesity, musculoskeletal problems, and loss of function with aging.

- **STRENGTHS**

The application has a number of strengths and delivers a clear and compelling need for the creation of interventions that promote better health and disease management. More specifically, the applicants have presented substantial evidence supporting the utility of behavioral science theories, models, and interventions in affecting changes in smoking, diet, and physical activity. It is also understandable that small improvements in the management of chronic diseases such as diabetes could lead to substantial savings in health care costs. The USC endowed chair **(recommended for funding)** is to be located and will leverage strengths already developed within the Department of Exercise Science in the Arnold School of Public Health, and the MUSC chair **(not recommended for funding)** is to be aligned with the College of Nursing. Another strength of the application is the commitment from Health Sciences South Carolina (HSSC) to pledge $1.6M in matching funds.

- **WEAKNESSES**

The proposal develops the need and opportunity for the creation of an endowed chair at USC and a second chair at MUSC. However, the lack of physical proximity of the two campuses creates a physical barrier for establishing synergy between these two complimentary programs, and the reviewers were not convinced that adequate mechanisms were identified to assure programmatic synergy. Also, the application did not sufficiently address how and where these new chairs would secure the programming/technical expertise needed to develop the proposed digital technologies. It was not clear that the chairs themselves would have the requisite skills to create the programming that will ultimately enable the anticipated interventions. Some concern was also expressed among the reviewers that MUSC may not be fully committed to the creation of its chair.

- **ECONOMIC IMPACT**

The proposal clearly articulates the opportunity for the proposed chairs to impact the local economy through (1) the creation of marketable technology, (2) the creation and recruitment of companies focused on lifestyle interventions, and (3) increased competitiveness for extramural funding by university researchers. Another benefit would be the potential for these technologies to reduce health care costs across South Carolina and beyond. This potential would seem to be supported by HSSC's contribution of matching funds. Relative to other applicants, this proposal has a lower potential for direct wealth creation, but also a lower risk of failing to deliver its potential.

- **RECOMMENDATION**

The reviewers regard this as a timely proposal which would be very supportive of a number of efforts underway in South Carolina. However, given the concerns noted above, funding was not recommended for the MUSC chair at this time. It is strongly recommended that the USC chair be funded as proposed. The Review Panel recommends that the proposal be rewritten with focus on the MUSC chair and be resubmitted for consideration for funding by September 2009.

CATEGORY 2B: RECOMMENDED TO BE REVISED AND SUBMITTED DURING NEXT YEAR'S PROPOSAL CYCLE

Clinical-Translational Biomedical Informatics – MUSC
$5,000,000 requested
Chairs: MUSC (1)
Not recommended for funding; revise and resubmit for 2009-2010 proposal cycle.

- **DESCRIPTION**

This proposal seeks state support to create a Center of Economic Excellence in Clinical-Translational Biomedical Informatics. The objective of the proposed CoEE is to "develop methodology to enhance biomedical informatics applications in healthcare delivery and research including state-wide data sharing." This center will use the tools of biomedical informatics and computational biology to find new and efficient approaches for developing data linkages and improving the understanding of the large masses of data that will be stored. This is an extremely important goal to pursue. Most medical schools and health care systems have poorly designed databases and do not have the capability to link across disparate systems. It is estimated that major health care savings would result from a fully functional and integrative system for storing and mining health care records. Moreover, considerable federal funding is becoming available for supporting such efforts as the one proposed in this application.

- **STRENGTHS**

Several strengths exist for this proposal. First, the area proposed for research and development is extremely important and timely. As noted in the proposal, having a common statewide medical record available to primary providers of healthcare would allow better management of patients, better access to prevention, and the development of a patient-centered medical home. In addition, South Carolina is already a leader in partnering between universities, medical schools and hospitals in the State with the Health Sciences South Carolina collaboration. This organization received a $21M grant from Duke Endowment to create a state-wide infrastructure to support translational research. Once fully developed and with additional resources as proposed in this CoEE, the goals in this proposal would be attainable. Another positive for this proposal is that MUSC has received a review score likely to ensure funding of its NIH Clinical and Translational Science Award (CTSA). The CTSA would provide another vehicle supporting the creation of a state-wide infrastructure for bioinformatics.

- **WEAKNESSES**

Several weaknesses of this proposal prevent it from being recommended for funding this year. First, the principal investigator, Dr. Barbara C. Tilley, has recently announced that she is leaving to take a position at the University of Texas Health Science Center at Houston. Dr. Tilley is a national expert whose loss will diminish the current capabilities necessary for this CoEE. A second concern is that the Department of Biostatistics, Bioinformatics and Epidemiology has been restructured, with Bioinformatics moved to the Basic Sciences (Biochemistry) and Biostatistics moved to the Department of

Medicine. It was not clear to the Review Panel what led to these changes or why they were necessary. The revised proposal should address whether MUSC intends to recruit a replacement for Dr. Tilley and describe the impact of the restructuring on the needed support for the CoEE. Another concern was related to the weak case made for economic impact (see below). Finally, it was not clear that a new CoEE needed to be created for this effort. The review panel felt that seeking an endowed chair and programmatic support was appropriate, but the state funding could be placed into an already existing unit such as the South Carolina Clinical and Translational Research Institute.

- **ECONOMIC IMPACT**

It is proposed that this CoEE would lead to the creation of patents which could be licensed to both established and start-up companies. In addition, the proposal states that success in creating a statewide sharing of medical and genetic records could attract pharmaceutical companies to South Carolina. The evidence for such impacts is not very strong. In addition, many states are trying to create a similar clinical bioinformatics program for sharing of data records and it is not clear that South Carolina would attract start-up companies to form and remain in the state. There are, however, economic impacts that are likely to result from this CoEE. Hiring of an outstanding chair would result in increased research funding in clinical bioinformatics. In addition, the most significant impact would be a reduction in health care costs that would occur due to a powerful state-wide medical records system. There might also be the possibility of fees for services generated by mining of the data records and implementing the new databases at hospitals and health care provider offices throughout the state.

- **RECOMMENDATION**

The Review Panel regards this as a timely proposal which would be very supportive of a number of efforts underway in South Carolina. However, given the concerns noted above, funding was not recommended at this time. Recruiting a replacement for Dr. Tilley and assessing the effects of the revised department will take several months. It is strongly recommended that the proposal be revised and resubmitted next year. The revised proposal should also include a description of how this CoEE will collaborate with the CTSA.

Arthritis and Connective Tissue Disease – Medical University of South Carolina
$5,000,000 requested
Chairs: MUSC (2)
Not recommended for funding; revise and resubmit for 2009-2010 proposal cycle.

- **DESCRIPTION**

This proposal requests state funding for two endowed chairs, one in Clinical Translational Research ($2M) and the second in Drug Development ($2M), to be part of a new Arthritis and Connective Disease Center of Economic Excellence. The remainder of the funds ($1M) will be for programmatic endowment. The purpose of the new CoEE is to develop novel and effective anti-inflammatory and anti-fibrotic drugs. The center will build on a strong foundation of clinical translational research in the field of connective tissues. There is significant expertise at MUSC in scleroderma and lupus, which are characterized by widespread fibrosis and immune-related inflammation, respectively.

- **STRENGTHS**

The CoEE will build on considerable expertise in the fields of scleroderma and lupus research and an excellent record of funding for these areas. Dr. Gary Gilekson has a highly successful clinical and translational research program in the study of lupus while Drs. Maria Trojanowska, Stan Hoffman and Richard Silver have a highly collaborative program studying mechanisms of fibrosis development in scleroderma. The MUSC Rheumatology Program is ranked in the top 20 by *U.S. News & World Report* and has maintained an average funding level of over $4M for the past 5 years. In addition, they have been successful with private foundation gifts. Few groups in the world are comparable in the study of connective tissue diseases.

A concern was expressed that scleroderma and lupus affect small populations relative to other diseases such that funding for drug development would not be readily available. The site visit presentations demonstrated that fibrosis and inflammation in these diseases share underlying mechanisms with more common related diseases.

The new center can also take advantage of several related CoEEs: Proteomics; Renal Disease Biomarker; Cancer Drug Discovery; Cancer Therapeutics; Lipidomics; and others. There is already in place a well-organized network of cooperating rheumatologists and access to patient data. Overall, this center will offer a very attractive environment for the recruitment of two new chairs.

- **WEAKNESSES**

While the potential of nitric oxide generation and sphingosine receptor antagonism (lupus) or agents that might affect TGF beta (scleroderma) appear promising leads for yielding new drugs, the caveolin approach, while novel, is less convincing as a pharmaceutical but still has possibilities. Also, the use of "Arthritis" in the center name is misleading. There is no current research strength in this area, nor is there an explicit plan for hiring into this area. There were other concerns about the plans presented for economic development which are explained below.

- **ECONOMIC IMPACT**

The challenges to developing novel and effective anti-inflammatory or anti-fibrotic drugs are immense. The MUSC Rheumatology Department provides a significant foundation to support such efforts, including established networks to rheumatologists throughout South Carolina for access to data and patients relevant to clinical trials. The availability of resources for moving to Phase I clinical trials will be important to speed the development of therapeutics, especially in an environment where no new drug for a disease such as lupus has been introduced in over 40 years.

The plan for developing practical therapeutics is not as detailed or clear as it might have been. Framework, design, methods and analyses are not well-integrated in the plan for drug development. It is likely to take far more time than the proposal suggests to develop therapeutics which will delay the economic benefits of the proposed center being realized. The case that is easier to make is for development of a research platform that will serve to launch diagnostics first and later therapeutics. A platform approach often offers many more (sometimes unexpected) opportunities.

- **RECOMMENDATION**

Overall, this is an impressive group of researchers which wishes to consolidate and expand its strengths by adding two endowed chairs in the area of fibrosis and inflammation research. The group's well-funded and collaborative track record, coupled with a network of physicians and available patient data and other cooperating CoEEs, offers prospective chair holders a very attractive package. However, the PIs need to make a more convincing case for economic impact, including a better explanation for the development of therapeutics. Lastly, arthritis is not a focus of the new CoEE and should not be part of the center name.

Therefore, it is recommended that the proposal be revised to include a more robust plan for economic development and to remove "Arthritis" from the proposed center's title, and be resubmitted for funding consideration during the 2009-2010 cycle.

Sustainable Development – Clemson University
$4,000,000 requested
Chairs: Clemson (1)
Not recommended for funding; revise and resubmit for 2009-2010 proposal cycle.

- **DESCRIPTION**

The revised proposal, provided to the Review Panel on May 4, seeks state support for one endowed chair ($4.0 million) to create a Center of Economic Excellence in Sustainable Development. The objective of the proposed CoEE is to catalyze innovations in technologies, materials, and policies that foster sustainable development. This center will align with Clemson University's Restoration Institute and Cyber-Institute to foster research and development at the interface of sustainability, restoration and information technology. The proposal focuses on three broad research objectives including new technologies, interactions between the built and natural environments, and design product perspectives on sustainable development. The Case Study on "The Intelligent River" illustrates the potential of advancing technologies to meet the challenge of sustainable natural resources. The desired outcome of such initiatives is economic development that is responsive to both environmental and quality of life concerns.

- **STRENGTHS**

The general area proposed for research is unquestionably important to advancing sustainable economic development. The "Intelligent River" project provides a powerful illustration of a multi-disciplinary approach at Clemson to link aspects of water resources, land use management, energy, and climate change. Real-time management of water resources across the state of South Carolina through the application of an advanced cyber-infrastructure could establish the state as a leader internationally. In a more general sense, Clemson University appears committed to advancing sustainability as a major institutional priority, for example, in areas that investigate the impacts of the built environment on natural resources, ecosystem services, and on biological, chemical and physical processes. Momentum is building to create interdisciplinary degree programs at Clemson in sustainable development. There is an impressive array of existing CoEEs, programs and centers at Clemson that have overlapping interests in sustainable development, for example, in restoration ecology, renewable energy, natural resources, sustainable design, land use planning, real estate development, and watershed

management. Existing partnerships in aspects of economic, environmental and social aspects of sustainability include a diverse mix of universities in the region, as well as governmental agencies and non-profit organizations. The new federal focus on developing green technologies also bodes well for enhancing support for research efforts such as the ones proposed in this application. Finally, there is a major pledge in hand from a private donor ($2 million) to support a chair related to sustainable development.

- **WEAKNESSES**

Several weaknesses of this proposal keep it from being recommended for funding this year. This "triple bottom line" objective of economic, environmental, and social benefit is embedded in a myriad of approaches to a sustainable future, including initiatives being pursued at virtually every major research university. The original proposal on "Sustainable Development" was ranked at the bottom of CoEE proposals being considered in this round of competition by the technical reviews. Despite the improvements made in the revised proposal to better emphasize "niche areas" where Clemson is positioned to lead, such as the integration of information technology with natural resources management, the proposal remains vague on addressing broader goals of sustainable development. For example, it is not clear how one CoEE chair and associated center can be effectively integrated with the complex infrastructure at Clemson to have a broad-ranging impact on its collective enterprise around sustainability. Probably the weakest aspect of the proposal is the connection to economic development (see the following section). In short, the rationale and justification for a CoEE investment is not compelling. The private donor pledge does not specify a match to a *CoEE chair*, only that a Clemson chair be created in "sustainable development" that has a strong focus on establishing new degree programs that enrich a workforce devoted to principles of sustainability.

- **ECONOMIC IMPACT**

It is proposed that the CoEE would facilitate public-private partnerships and the development of new industries in South Carolina to deliver new technologies, materials, designs and products linked to "green economy" jobs. There are clearly opportunities to create and support jobs in aspects of the government-university-industry partnerships related to projects such as "The Intelligent River." However, the proposal lacks a clear vision or framework around commercialization of research and the transfer of products or services to the private sector interested in sustainable development. The "business model" simply is not well established. For example, the proposal begs the questions of what components developed through the proposed CoEE might be open source, fee for service, or generate intellectual property that could be out-licensed or form the basis of start-up companies. Private sector interests were briefly referenced, including GE Wind Energy, Microsoft, IBM and Google. However, the industry links to the proposed CoEE are certainly not well developed, especially in the context of South Carolina's industry clusters. Although metrics proposed include jobs created, public-private partnerships created, and economic value created through IP, there is no discussion of what specific targets or timelines might be associated with such deliverables. In short, it is hard to make the "leap of faith" that the proposed CoEE chair would foster long-term economic growth in South Carolina related to sustainable development.

- **RECOMMENDATION**

The review panel was impressed by the diversity of existing research and outreach efforts at Clemson University linked to issues of sustainability. However, given the weaknesses and concerns related to economic development as summarized above, funding is not recommended at this time. The review panel felt that seeking an endowed chair and associated programmatic support was appropriate, but that further effort is needed in the short-run to fully leverage prior CoEE commitments to Clemson in associated areas. The panel encourages further development of the CoEE proposal, with the possibility of resubmission for consideration next year.

Brain Digestive Diseases – MUSC / USC
$5,000,000 requested
Chairs: MUSC (1); USC (1)
Not recommended for funding; revise and resubmit for 2009-2010 proposal cycle.

- **DESCRIPTION**

MUSC in collaboration with USC proposes to establish an international center in the diagnosis, treatment, and research on brain-digestive diseases, an increasingly recognized group of disabling medical disorders. They will appoint two new endowed chairs, one in Neuro-Intestinal Proteomics and the second in Clinical Neuro-Intestinal and Translational Sciences ($2M each). The remainder of state funds is for programmatic endowment ($1M). The chairs will head a Discovery Research Division and a Translational Science Research Division, respectively, within the center. Their goals are to develop new diagnostic tools mainly through proteomics approaches in order to identify disease biomarkers to discover potential therapeutic targets. Once targets are identified, drugs that interfere with their function will be sought. The chair in translational sciences will also establish ties with the larger academic community and with industry.

- **STRENGTHS**

There is an emerging body of evidence for bi-directional linkage between the nervous (central and peripheral) and gastrointestinal systems. The proposed center is an attempt to bridge and expand the complementary scientific and medical expertise of the two campuses in these areas as MUSC and USC have established expertise in neuropsychiatry, oncology, and gastroenterology. One promising example in this area is the possible linkage of pancreatic cancer to BDD markers which is especially intriguing as there are no early warning signs of this devastating disease. The MUSC and USC groups are situated to take advantage of this new information and take a leadership role in the field.

There will be support from the Proteomics Core Facility (CoEE) for the mechanics and high throughput capacities for the project, and the Brain Imaging CoEE is expected to provide an accelerated pathway for identifying neuro-anatomic substrates associated with the studied syndromes. All six member institutions of HSSC have been involved in planning for the center and will provide sources for tissue and outcome tracking.

- **WEAKNESSES**

There are concerns about the length of time needed for biomarker identification and validation and the difficulties inherent in a proteomics-only approach. The biomarkers are expected to lead to therapeutic targets as well. The proposal anticipates 5-10 new protein targets for drug development in the first 5 years which seems particularly ambitious for proving both specificity and selectivity of the targets for the diseases of interest. There is no clear plan for the coordination of the large number of contributing investigators. This is a key feature of the proposal, but was not articulated. Similarly, there is little explanation of planned training for graduate students, fellows, or postdoctoral fellows in the CoEE except in the area of intellectual property innovation and technology transfer.

A prospective candidate for the CoEE chair in translational sciences, Dr. Boris Tartakoff, was present at the site visit and part of the presentation. He has an extensive background in the neuro-psychopharmacology of alcoholism at the University of Colorado and spent time at the NIAAA, including service as acting Deputy Director. How his experience will add to the BDD focus was not clearly explained. In the area of commercialization, Dr. Tartakoff is founder and president of Lohocla Research Corporation which has run for the past 15 years with only SBIR support. Neither Dr. Tartakoff nor the proposal's Co-PIs, Drs. Uhde and Narasimhan, gave convincing evidence that there was a strong strategic plan for the new CoEE.

- **ECONOMIC IMPACT**

As for every CoEE award, the economic benefits of this CoEE in the short term would be hiring as a result of new external funds brought to the universities by the new endowed chair holders. In the long term, diagnostic and therapeutic discoveries may be expected from the center that will generate licensing revenues and possibly spin-off companies. However, the prediction of 5-10 new protein targets for drug development in the first 5 years is ambitious. Dr. Tartakoff, a proposed chair candidate, does not appear to have the range of commercialization expertise that would best serve the center.

- **RECOMMENDATION**

There appears to be expertise at MUSC and USC in several fields related to the proposed CoEE. However there is not a coherent plan for implementation of the varied collaborations and interactions that would help to drive the ambitious goals of the program.

The external review committee recommends that this proposal be revised and resubmitted to the 2009-2010 funding cycle.

SUMMARY OF 2007-2008 COEE ONSITE REVIEW PANEL AWARD RECOMMENDATIONS

Category One Recommendations	**Chairs to Clemson**	**Chairs to MUSC**	**Chairs to USC**	**Total $**
Tissue Systems Characterization	1			$3,000,000
Lipidomics, Pathobiology and Therapy		2		$5,000,000
Nuclear Science Strategies			1	$3,000,000
TOTAL	**1**	**2**	**1**	**$11,000,000**

Category Two-A Recommendations **[proposed MUSC chair to be considered for September 2009 resubmission]**	**Chairs to Clemson**	**Chairs to MUSC**	**Chairs to USC**	**Total $**
Technology Center to Enhance Healthy Lifestyles		TBD	1	$2,500,000
TOTAL				**$2,500,000**

Category Two-B Recommendations **[resubmission possible starting in 2010]**	**Chairs to Clemson**	**Chairs to MUSC**	**Chairs to USC**	**Total $**
Sustainable Development	TBD			TBD
Clinical-Translational Biomedical Information		TBD		TBD
Arthritis and Connective Tissue Disease		TBD		TBD
Brain Digestive Diseases		TBD	TBD	TBD

Category Three Recommendations	**Chairs to Clemson**	**Chairs to MUSC**	**Chairs to USC**	**Total $**

Part Five: Conclusion

As noted in previous reports, the Review Panel believes that the CoEE program is exceptionally strong. There is no question that the investments made in the previously and currently recommended programs are beginning to yield extraordinary benefit for South Carolina.

Despite the great strengths of this program, South Carolina cannot assume that current achievements will ensure competitiveness. The competition to be a leader in the knowledge economy is getting tougher, as more and more states and nations appreciate the need to rethink their educational and research structures. The race will not end any time soon, and it would be a disaster for South Carolina to pause, much less drop this program, just as others are beginning to consider similar strategies. South Carolina needs to continue its bold but also balanced and prudent investments in the knowledge economy.

The Review Panel strongly believes that this program should be continued and strong consideration should be given to creating new funding to aid the universities in offering competitive start-up packages to the endowed professors recruited. In addition, there is considerable need for pre-seed funding for start-up companies being formed out of the CoEEs. Finally, consideration should be given for funding to enhance technology transfer on all campuses as well as shared infrastructure to enhance the movement of intellectual property out of the universities.

This is an outstanding program which demonstrates the enlightened thinking of State and University leaders. It is attracting national attention and will produce new ideas resulting in the creation of new, high quality jobs for the citizens of South Carolina.

APPENDIX A

South Carolina Centers of Economic Excellence Funded Proposals

In 2002, the South Carolina General Assembly passed the Research Centers of Economic Excellence Act in order to promote growth of the knowledge-based economy in South Carolina. Oversight of the Centers of Economic Excellence (CoEE) Program is provided by the S.C. Centers of Economic Excellence Review Board. The South Carolina Commission on Higher Education approves the budget for the CoEE Review Board's operations and also provides staff support for the program's day-to-day operations. South Carolina Education Lottery funds in the amount of $180 million have been appropriated for the program since the 2002-2003 Fiscal Year. Over the last six years, 42 research proposals totaling $172.6 million have been approved for funding. South Carolina's three research institutions are required to raise dollar-for-dollar, non-state matching funds in order to access state funding.

The most current information on the CoEE Program is available at www.sccoee.org . A list of funded proposals follows:

Funding Year 2002-2003			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Automotive Systems Integration	1	$5 million
Clemson	Automotive Manufacturing	1	$5 million
USC	Nanostructures	1	$4 million
USC/MUSC	Brain Imaging	3*	$5 million
MUSC	Proteomics	1	$4 million
MUSC	Neuroscience	3	$3 million
MUSC/College of Charleston	Marine Genomics	2	$4 million
Total Awarded in 2002-2003		**12**	**$30 million**
Funding Year 2003-2004			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Automotive Design & Development	1	$5 million
Clemson	Electronic Systems Integration	1	$3 million
Clemson	Photonic Materials	1	$5 million
USC	Polymer Nanocomposites	1	$3.5 million
USC	Hydrogen & Fuel Cell Economy I **	2	$2.5 million
MUSC/Clemson/USC	Regenerative Medicine	3	$5 million
MUSC/USC	Translational Cancer Therapeutics	2	$5 million
Total Awarded in 2003-2004		**11**	**$29 million**

* Revised to three chairs by act of the CoEE Review Board on January 12, 2009.
** The Hydrogen & Fuel Cell Economy CoEE was approved during 2003-2004. Funding for one half of this CoEE was provided in 2003-04, the other half in 2004-2005.

Funding Year 2004-2005			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Restoration [WITHDRAWN]	—	[$3 million]
Clemson	Electron Imaging [WITHDRAWN]	—	[$5 million]
USC	Renewable Fuel Cells	1	$3 million
USC	Hydrogen & Fuel Cell Economy II*	[See 03-04.]	$2.5 million
USC/Coastal Carolina	Tourism & Economic Development	1	$2 million
MUSC	Gastrointestinal Cancer Diagnostics	2**	$5 million
MUSC/USC	Cancer Drug Discovery	4	$5 million
MUSC/USC	Vision Science	3	$4.5 million
Total Awarded in 2004-2005		**11**	**$22 million**

Funding Year 2005-2006			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Supply Chain Optimization & Logistics	1	$2 million
Clemson	Urban Ecology and Restoration	1	$2 million
Clemson	Advanced Fiber-Based Materials	1	$4 million
Clemson	Molecular Nutrition [WITHDRAWN]	—	[$2 million]
USC	Solid Oxide Fuel Cells	1	$3 million
USC/MUSC	Childhood Neurotherapeutics	3	$5 million
MUSC	Molecular Proteomics in Cardiovascular Disease & Prevention	2	$5 million
MUSC/USC	Clinical Effectiveness & Patient Safety†	3	$5 million
Total Awarded in 2005-2006		**12**	**$26 million**

Funding Year 2006-2007			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson/MUSC	Health Facilities Design & Testing	2	$5 million
USC	Rehabilitation and Reconstruction Science	1	$5 million
USC	Strategic Approaches to Electricity Production from Coal	1	$5 million
USC/MUSC/Clemson	Healthcare Quality	2	$5 million
USC/Clemson	Senior SMART™ Center	3	$5 million
MUSC	Tobacco-Related Malignancy	2	$5 million
MUSC/USC	Stroke	3	$5 million
Total Awarded in 2006-2007		**14**	**$35 million**

* The Hydrogen & Fuel Cell Economy CoEE was approved during 2003-2004. Funding for one half of this CoEE was provided in 2003-04, the other half in 2004-2005.

** Increased from one to two by act of the CoEE Review Board on September 8, 2008.

† On September 9, 2008, the CoEE Review Board approved a revision to this proposal which relinquished Clemson University as a collaborative partner and transferred the CoEE chair at Clemson to MUSC.

± The SeniorSMART CoEE was approved in 2007-2008. Funding was provided from 2006-2007 dollars.

Funding Year 2007-2008			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Optoelectronics	1	$2 million
Clemson	Cyber-Institute	1	$2 million
USC	Nanoenvironmental Research & Risk Assessment	1	$3 million
USC	Nuclear Science and Energy	1	$3 million
MUSC	Renal Disease Biomarker	2	$5 million
MUSC/Clemson	Cancer Stem Cell Biology	2	$5 million
MUSC/USC/Clemson	Advanced Tissue Biofabrication	3	$5 million
MUSC/USC/SCSU	Cancer Disparities	3	$3.6 million
MUSC/USC	Medication Safety & Efficacy	1	$2 million
Total Awarded in 2007-2008		**14**	**$30.6 million**

* The Cancer Disparities CoEE and the Medication Safety & Efficacy CoEE were approved in 2008-2009. Funding was provided from 2007-2008 dollars.

Program Totals	
TOTAL FUNDS AWARDED (2003-2008)	**$172.6 million**
TOTAL LOTTERY APPROPRIATIONS (2002-2009)	**$180 million**

Research Institution Totals			
Institution	**Number of Centers**	**Number of Endowed Chairs**	**State Funds Drawn**
Clemson University	11	14	$24,270,458
University of South Carolina	14	26	$24,664,910
Medical University of South Carolina	17	35	$42,501,517
TOTALS	42	75	$91,436,885

[Last updated June 1, 2009.]

APPENDIX B

Paula Harper Bethea
Chair

May 18, 2009

President James F. Barker
Clemson University
201 Sikes Hall
Clemson, SC 29634

President Raymond S. Greenberg
Medical University of South Carolina
135 Cannon St., Suite 101
Charleston, SC 29425

President Harris Pastides
University of South Carolina
Osborne 206
Columbia, SC 29208

Dear Presidents Greenberg, Barker and Pastides:

At the recent CoEE Onsite Review Panel, each institutional president independently discussed during private sessions with the Panel the general programmatic philosophy of whether the Research Centers of Economic Excellence (RCEE) Act intended for proposals to be "chair-based" or "center-based." There appeared to be a general opinion among the institutions that the CoEE Review Board had mandated a "center-based" interpretation of the RCEE Act.

President Barker made a statement to the effect that the original structure of the Clemson University International Center for Automotive Research (CU-ICAR) was no longer viable; that is, the CoEE Review Board no longer favored the creation of a general umbrella center, such as CU-ICAR, under which a number of chairs in the amount of $2 million to $5 million could be situated. Another example of such an "umbrella center" might be USC's Future Fuels Initiative, under which are situated USC CoEEs such as Solid Oxide Fuel Cells, Renewable Fuel Cells for the Fuel Cell Economy, Hydrogen Fuel Cells, etc.

I write to you today to clarify that the Review Board has not imposed a preferred model, contrary to what seemed to emerge in discussions with the Panel. In fact, in 2006, the CoEE Review Board created a flexible policy with respect to "chair-based" or "center-based" proposals. When it became clear that institutions were following different models, the CoEE Review Board revised the Program *Guidelines* in the following manner:

> Individual proposals may be for (a) a single endowed professorship; (b) single or multiple professorships clustered in a new research center; or (c) single or multiple professorships clustered in an already existing research center. [Section XIV-e]

This version was made to allow for flexibility and to avoid imposing one model on everyone.

Thus, there exists a number of ways by which a senior research institution might align its CoEE within current institutional structure. The CU-ICAR and USC Future Fuels model is acceptable. Also acceptable is the Clemson practice of incorporating CoEEs into currently existing research centers, such as the Photonic Materials CoEE with the broader Center for Optical Materials Science and Engineering. And, of course, it remains acceptable for an institution to create a single CoEE chair which is not interrelated to any existing institutional research center (Tourism and Economic Development CoEE at USC).

I think it important not to confuse how endowed chairs may be administratively structured with the branding of the program by our marketing firm as the CoEE program. Perhaps this is the source of confusion as to what is allowable.

The On-Site Review Panel did express some concern about the proliferation of many small Centers as opposed to consolidation of a critical mass of chairs under broader Centers. While the pros and cons of the different approaches were briefly discussed, the flexibility inherent in the revised *Guidelines* noted above remains in effect.

Please let me know if you have any additional questions on this matter.

Sincerely yours,

Gail M. Morrison, Ph.D.

CHE Deputy Director, Director,
Academic Affairs & Licensing

cc: Ms. Paula Harper Bethea, Dr. Chris Przirembel, Dr. John Raymond, Dr. Rose Booze.

South Carolina Centers of Economic Excellence
Onsite Review Panel Report

June 7, 2010

The Onsite Review Panel met in Charleston, South Carolina on April 25-27, 2010, for review of proposals submitted by Clemson University, the Medical University of South Carolina, and the University of South Carolina. During the site visit, the Onsite Review Panel heard presentations from individuals at each campus who had submitted proposals to the South Carolina Centers of Economic Excellence (CoEE) Review Board as well as from senior leadership of each campus. Following Onsite Review Panel deliberation both in person, via telephone, and email, the merits of each proposal were assessed.

This document presents the findings and recommendations of the Review Panel and is organized as follows: **Part One** provides an overview of the CoEE Program; **Part Two** provides general findings and recommendations from the Onsite Review Panel; **Part Three** offers suggestions for improving program operation including suggestions for additional funding and infrastructure needed to support the CoEE Program; **Part Four** describes the Review Panel's recommendations for funding based on its review of the 2009-2010 proposals; and **Part Five** offers a summary conclusion from the Onsite Review Panel.

Part One: Program Overview

Program Description and History. In 2002, the South Carolina General Assembly enacted the South Carolina Research Centers of Economic Excellence (RCEE) Act. The legislation originally designated $200 million through 2010 from the South Carolina Education Lottery to establish Centers of Economic Excellence by creating unique endowed professorships at South Carolina's three senior research institutions: Clemson University, the University of South Carolina, and the Medical University of South Carolina. In 2008, the General Assembly revised the RCEE Act to provide for $30 million in guaranteed funding each year provided all lottery scholarships have been funded, and provided at least 80% of all appropriations have been awarded through the most recent previous fiscal year.

Awards are made through a competitive application process which encourages collaboration among the three research institutions and with other higher education institutions in the state. Funding decisions are made by an 11-member Review Board appointed by the Governor (3 appointees), the President Pro Tempore of the Senate (3 appointees), the Speaker of the House of Representatives (3 appointees), the Chair of the Senate Finance Committee (1 appointee), and the Chair of the House Ways & Means Committee (1 appointee). The CoEE Review Board approves new CoEEs and provides program oversight. The three research university presidents serve as ex-officio, non-voting members of the Review Board. Staff and operational support for the CoEE program are provided by the Commission on Higher Education, which also approves the program annual operating budget.

Current Program Status. The program is currently in its eighth year of soliciting and reviewing proposals from the state's three research universities. This year, five proposals were submitted to the Onsite Review Panel for evaluation.

Over the last seven years, the Review Board has approved funding for 46 research proposals from USC (16), MUSC (18), and Clemson University (12) and their partner institutions (College of Charleston, South Carolina State University, and Coastal Carolina University), totaling $186.6 million in State Lottery funds. To date, $121.5 million in state funds have been drawn down and distributed to the institutions, and the institutions report $156.9 million in matching fund pledges, of which $131.7 million has been received.

The 46 approved CoEEs represent a diverse palate of research fields. A complete list of the funded centers is appended to this report (Appendix A). Eighteen CoEEs (40%) are collaborative efforts among the state's three research universities.

The 2009-2010 funding cycle included five individual proposals:

Institution(s)	Project Title	Amount Requested	Chairs
Clemson	Sustainable Development	$4 million	1
MUSC	S.C. Longevity Center	$5 million	1
MUSC	Center for Inflammation and Fibrosis Research	$5 million	2
USC	Advancement of Health Care	$5 million	1
USC	Data Analysis, Simulation, Imaging & Visualization	$2 million	1
TOTALS	**5 Proposals**	**$21 million**	6
	Available 2009-2010 Funding	**$12 million ***	

* Funding for the 2009-2010 CoEE proposal cycle derives from $12 million in accrued program interest from the Centers of Excellence Matching Endowment.

Evaluating the Proposals. The process of assessing the quality and viability of each proposal proceeded in several phases. **The first phase** involved submitting the proposals via email to external reviewers coordinated by the American Association for the Advancement of Science (AAAS) to determine the technical and scientific merit of each research project. AAAS provided consensus reviews based upon input from a minimum of three reviewers per proposal. Reviewers were asked to assign points to the proposal in

each of four categories: Scientific and Technical Merit (up to 40 points); Approach, Process, and Execution (up to 25 points); Innovation (up to 25 points); and Infrastructure, Support, and Collaboration (up to 10 points). The maximum point total is 100. This was the second year the CoEE Program contracted with AAAS to provide composite reviews.

The second phase involved the Onsite Review Panel. Each proposal was assigned a lead reviewer and a secondary reviewer from the Onsite Review Panel. The role of the lead reviewer was fourfold: (1) to write questions to the principal investigator about the proposal for submission prior to the site visit; (2) to serve as the effective chair of the Onsite Review Panel for that proposal, including taking the lead in formulating questions; (3) to lead the Onsite Review Panel's internal discussion and ranking of the proposal during deliberations; and (4) to draft the narrative section required for the final report. The secondary reviewer provided reinforcement and support for the lead reviewer assigned to each proposal. In addition, the secondary reviewer wrote pre-site visit questions and led questions regarding economic impact during the site visit.

At the conclusion of each day's presentations, the Onsite Review Panel convened to discuss the proposals and began drafting a preliminary report. Finally, during subsequent weeks, under the guidance and direction of Onsite Review Panel Chair Dr. Tony Waldrop, the Onsite Review Panel communicated via telephone and email to arrive at final conclusions and funding recommendations. The 2008-2009 Onsite Review Panel included the following evaluators:

Name	**Title**	**Institution**
Jack Burns, Ph.D. *	Vice President Emeritus for Academic Affairs & Research	Colorado University
Rebecca Gunnlaugsson, Ph.D	Economist	S.C. Department of Commerce [non-voting]
Laura Levy, Ph.D. *	Associate Senior Vice President for Research	Tulane University
Richard Linton, Ph.D. *	Vice President for Research & Graduate Studies	University of Oregon
Maria Pellegrini, Ph.D. *	Former Vice President for Research Executive Director of Programs	W.M. Keck Foundation
Todd Sherer, Ph.D. *	Assoc. Vice President for Research & Director of Technology Transfer	Emory University
Tony G. Waldrop, Ph.D. * Chair, Review Panel	Vice Chancellor for Research and Economic Development	University of North Carolina at Chapel Hill

* Returning Review Panel Members

Part Two: General Findings and Recommendations

The 2010 CoEE Onsite Review Panel visited Charleston on April 25-27, 2010, to hear presentations from Clemson University, the University of South Carolina, and the Medical University of South Carolina. As usual, the staff of the South Carolina Commission on Higher Education provided exemplary support. In addition, the participating universities and the collaborating organizations ensured an environment which was well-organized and highly informative. Taken together with the extensive documentation provided in advance, the Onsite Review Panel believes it had access to sufficient information to make recommendations for funding. Those recommendations are provided in detail in Part Four of this report.

Emphasis was placed on evaluating the potential economic impact of the proposed programs. One reviewer was asked specifically to examine the proposed economic impact and to provide questions both in advance and during the site visit in order to probe the short and long-term economic potential. In addition, Rebecca Gunnlaugsson, Ph.D., Economist with the South Carolina Department of Commerce, served as a non-voting consultant to the Onsite Review Panel. She was a full participant with the committee in posing questions to the universities and in evaluating the proposals.

The extensive documentation on the CoEE Program, together with the opportunity to interact with university personnel and representatives of affiliated organizations, also provided the Onsite Review Panel with an opportunity to comment on the overall purpose, structure, and foundations of the program. The Onsite Review Panel was very impressed with the openness of senior institutional leadership in answering questions.

Success of the S.C. Centers of Economic Excellence Program

The Review Panel continues to be very impressed with the success that is being made in attracting high quality faculty as CoEE Endowed Chairs to South Carolina. It is very evident that strong progress is being made in reaching the intended goals of this program related to economic development. Already, 30 endowed professors and numerous other junior faculty have been recruited to South Carolina and have brought in grants totaling well over $120 million. At the end of the 2009 fiscal year, the CoEE Review Board reported that more than 3,200 jobs have been created as the result of the CoEE Program.

It is also clear that the CoEE program is attracting national attention and jobs to South Carolina. Columbia hosted the April 2009 National Hydrogen Association Conference and Hydrogen Expo, bolstering South Carolina's favorable position in the hydrogen industry. With 700 registered attendees and 2,000 public visitors, the conference nearly doubled attendance from past conferences. The CoEE Program was an integral part of this event. Several CoEE Endowed Chairs, researchers and students from USC's Hydrogen and Fuel Cell CoEE and Renewable Fuels CoEE participated and presented lectures. According to a new report, *State of the States: Fuel Cells in America*, released by the nonprofit organization Fuel Cells 2000, South Carolina is one of the top five states for fuel cell research,

CoEEs are also helping attract companies to South Carolina. For example, Trulite, which builds hydrogen fuel cell generators and hydrogen fuel canisters for commercial uses, is moving its manufacturing and administration to Columbia. The announcement could lead to 1,000 private, high-tech jobs in South Carolina over the next few years. In addition, Danish company Dantherm Power is in the initial stages of launching U.S. fuel-cell entry for stationary power through its Spartanburg-based manufacturing facility; another of Dantherm's few U.S. installation is already in Columbia.

In addition, a number of start-up companies have been formed from CoEEs. These include FirstString, which markets wound repair technology, and Cephos Corporation, which is involved in brain imaging technology. It should also be noted that the presence of CoEEs has attracted existing companies to establish a presence in South Carolina. Examples include the Timken Company, BMW and Michelin. which have all located corporate teams and offices at the Clemson University International Center for Automotive Research (CU-ICAR). It is estimated that more than 800 jobs have resulted from the relocations at CU-ICAR.

In FY 2009, American Titanium Works (ATW) also announced that, due to research synergies with the CoEE Program, it will build a world-class titanium mill in Laurens County. The company will invest an estimated $422 million and plans to employ 320 people at its new Laurens County facility. ATW also announced that it will establish its applications development and engineering technical center on the CU-ICAR campus. This technology center will create 40 additional engineering jobs that will specialize in prototype development and fabrication techniques for multiple industry sectors. Other recent corporate relocation announcements with direct ties to the CoEE Program include vehicle manufacturer Proterra and the wind turbine manufacturer the IMO Group.

The CoEE Program has had several impacts that are not directly economic in nature but which downstream will lead to extraordinary effects on the economy of South Carolina. There is exceptional collaboration taking place among the three research universities that was weak prior to the establishment of the program. The joint South Carolina School of Pharmacy (USC & MUSC) is a prime example of this cooperation. Other examples of CoEE-induced changes include Health Sciences South Carolina (HSSC), the clinical trials networks which have been formed, and the eIRB which has been established. Bringing research faculty, clinicians, and the corporate sector closer together throughout South Carolina has provided a rich environment for the creation of new research programs, new clinical treatments, and partnerships which can result in spin-off companies as well as improvement in the quality of life for all South Carolina citizens.

Additional evidence for the success of the CoEE program includes MUSC's recent Clinical and Translational Science Award from the National Institutes of Health and designation of the Hollings Cancer Center as a Comprehensive Cancer Center by the National Cancer Institute. Moreover, CoEE Chair Dr. Ken Reifsnider and his research group at the University of South Carolina recently received an Energy Frontier Research Award from the Department of Energy. This award of $12.5 million is the largest competitive research grant in USC history.

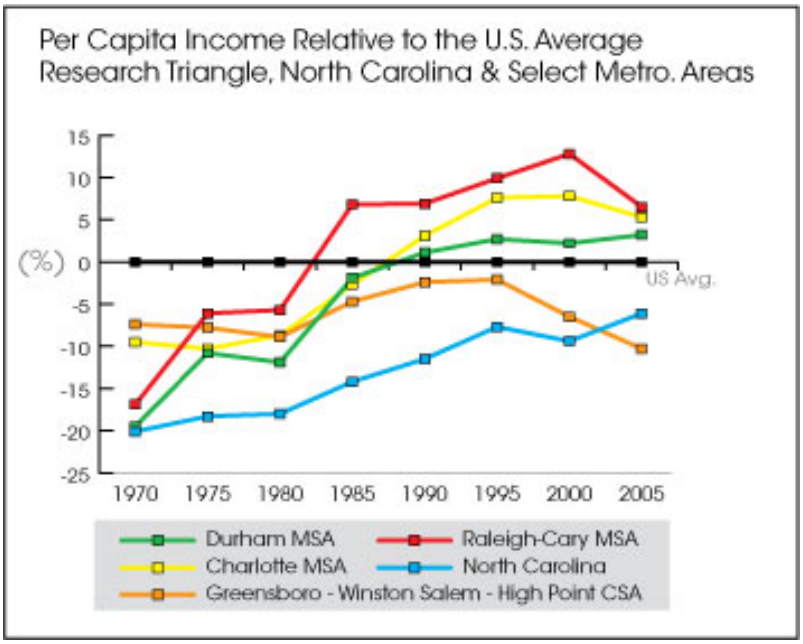
The National Association of State Universities and Land Grant Colleges has provided information about the economic impact of state funding provided to universities [See sidebar.] These effects are very much at play in South Carolina.

The Economic Impact of Public Universities

NASULGC Survey 2001

- *The average return on every $1 of state money invested in a public university is $5.*
- *For every $100 spent directly by a public university, its employees , visitors, and students spent $138 of their own funds.*
- *For every job on a public university campus, another 1.6 jobs are generated beyond the campus.*

As noted last year, efforts such as the CoEE Program take time to reap overwhelming rewards in job creation. For example, Centennial Campus at North Carolina State University and Research Triangle Park (RTP) took at least 15 years to exert a significant impact on the economy of the region and the State of North Carolina. As shown below, the RTP area (Durham and Raleigh areas) grew from below the national per capital income to above the national level following RTP development. The success of both these programs depended in no small part on enlightened leadership which understood the need for initial investment for long-term payoff.



The Onsite Review Panel is very aware of the severe economic situation in South Carolina as well as throughout the nation. We believe with utmost enthusiasm that this program should be continued. However, it should be noted that no new funding was provided in fiscal years 2008 through 2010. The Onsite Review Panel believes it is critically important to sustain the momentum of this exceptional program by providing funding in fiscal year 2011. As noted above, it is very clear that much of the basic foundation has been created to spur economic development in South Carolina. Continued investment will evoke considerable returns on these initial efforts that have created a core

infrastructure. Moreover, investments now should reap substantial returns following improvements in the State and National economic climate.

Part Three: Suggestions on Improving Program Operation

The Onsite Review Panel has been very impressed with the structure and operation of the CoEE Program. The committee would like to note areas where improvements have been made and recommends some additional ideas for consideration.

Proposal and Presentation Format

The Onsite Review Panel recommends that the proposals and presentations be focused to a greater degree on the specifics of what the CoEE will do instead of a long justification of need. This latter justification is clear in all of the proposals and presentations. However, the Onsite Review Panel needs more information on what would be done by the proposed programs as well as more detailed analysis of economic impact.

Up-Front Funding

As highlighted in last year's report, there are considerable costs associated with recruiting world-class faculty as CoEE Endowed Chairs. The research universities are now investing $2 million to $3 million over a period of one to three years for recruitment of a new faculty member. Recruitment costs include salaries for junior faculty, postdoctoral trainees, any students and staff who will accompany the CoEE Endowed Chair to South Carolina, as well as specialized equipment and laboratory renovation.

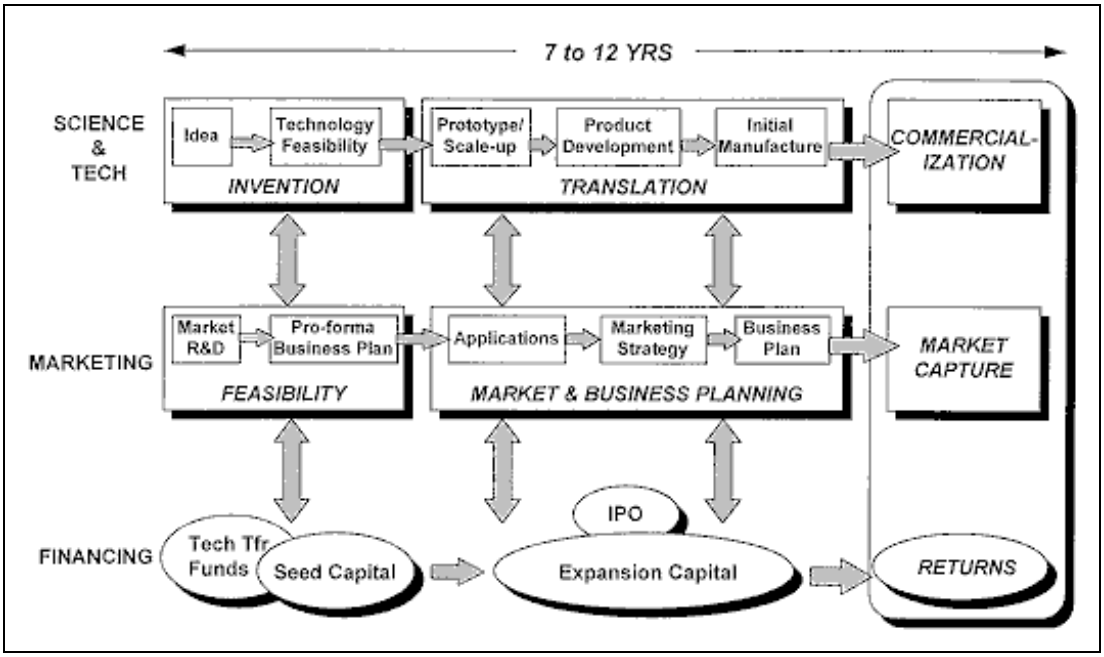
These recruitment costs, along with the current severe economic climate, have placed great constraints on the financial capability of the research institutions. Even before the latest economic situation, the institutions were having difficulties filling the CoEE Endowed Professor positions that were authorized. This was due to the up-front costs described above. The Onsite Review Panel is very concerned that the universities will have great difficulty in the current economic climate in finding the resources for CoEE up-front costs. We recommend that the State consider using some of the accrued interest in the CoEE Program to provide assistance with the direct costs needs in support of faculty recruited to endowed chairs. In addition, funding is needed to support the recruitment process of the CoEE Endowed Chairs.

Technology Transfer Resources

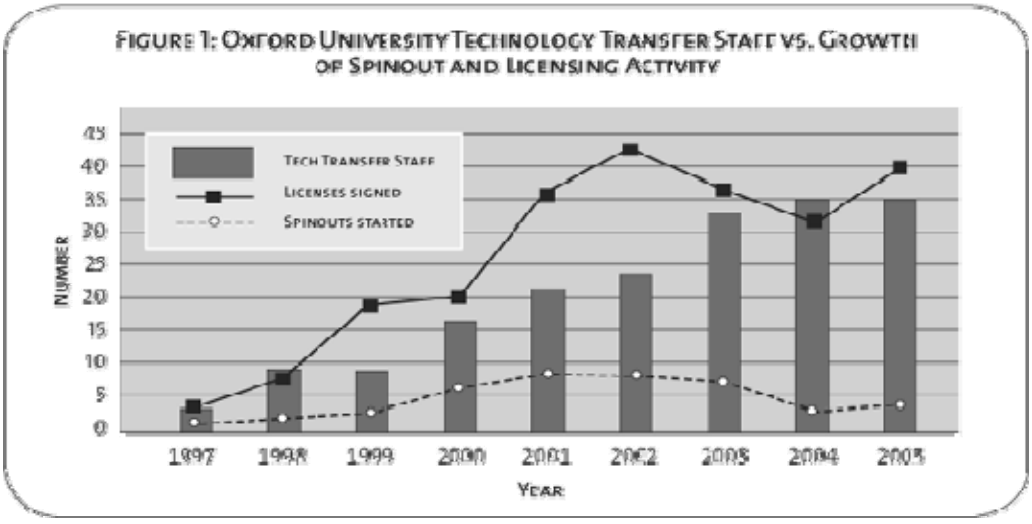
As noted above, the Onsite Review Panel believes that the CoEE Program has been very successful in recruiting outstanding CoEE Endowed Chairs to South Carolina. These recruits have begun to assemble strong teams who are successfully competing for external funding for research. In addition, intellectual property is being credited which clearly has commercial value and will lead to opportunities for licensing and formation of new companies. The Onsite Review Panel feels that it is critically important that the universities provide resources (staff, patent expenses, etc.) that will be necessary for managing these aspects which are critical for producing an economic impact.

Since economic impact is the ultimate goal of the Centers of Economic Excellence Program, it is crucial that the infrastructure for supporting institutional technology transfer continues to mature as research grows on the three campuses. It is not clear that a plan for meeting these resource needs has been developed by the universities.

As noted last year, the technology transfer process has a number of critical components which have to function smoothly in order for successful flow to the marketplace. It is exceedingly important that each step of this process be fully developed. Failure to do so will retard or even prevent reaching the ultimate goal of economic impact. The following insert shows that this process includes interactions among the three major components of technology transfer: science and technology; marketing; and financing. Moreover, the impact of this process takes time.



An example of Oxford University's (UK) investment in technology transfer staff is shown below:



Proliferation of Centers
Last year the Onsite Review Panel stated that a new center does not have to be created for each proposal area and recommended that the institutions consider adding new endowed chairs to existing "umbrella" centers where appropriate. This approach has several advantages. First, it would reduce the infrastructure costs (staff, general operation funds, etc.) needed for running each CoEE. It will also ensure close interactions between or among chairs who are focused in a particular area of research, increasing the likelihood of disclosures of new inventions. Increasing the number of distinguished professors in one unit rather than in several would enhance the national profile of the Center and would make it easier to recruit additional outstanding faculty as well as to generate external funding.

It appears that university leadership received this message and is in agreement with this premise. However, some of the university leadership still seem to be under the impression that this approach is not permissible, although the Program *Guidelines* clearly allow for it. CHE staff has already transmitted a letter (see Appendix B) to correct this misperception and to direct attention to the relevant section of the Program *Guidelines*. We recommend that the Review Board emphasize this point.

Promotion and Tenure
We have previously noted that the three universities should develop policies and procedures that reward success in technology transfer in the academic promotion and tenure process. Both entrepreneurship and collaborative and multidisciplinary efforts are critical to the success of the CoEEs and should be rewarded in the tenure and promotion process. We were impressed this year that all three universities are in agreement with this and are now starting to acknowledge these activities in their tenure and promotion processes.

Graduate Education
As in previous years, the Onsite Review Panel is still surprised by the relatively sparse reference to graduate education in the proposals, which is mandated by the Program *Guidelines*. As mentioned earlier, graduate students are very much at the core of successful research/economic development strategies. It is widely accepted among business and higher education leaders that the best form of technology transfer emanates from master's and doctoral graduates. We urge the research institutions to consider this in preparing proposals for next year.

Part Four: Recommendations for Funding

The Review Panel has provided three general rankings for the proposals it reviewed:

CATEGORY 1, for immediate funding.

The Onsite Review Panel believes that Category 1 proposals are of high quality, have clearly defined goals and objectives, have most of the key resources for success in place and, if awarded one or more endowed chairs, should find the needed match reasonably quickly and move quickly to success. Proposals in this category are *not* rank-ordered.

CATEGORY 2, meritorious, but with one or more significant failings that could be remedied. Resubmission is encouraged but should require a significantly revised proposal for examination by the Review Panel prior to receiving funding.

Category 2 proposals are similar to those in Category 1 in many ways but require at least one or more significant changes prior to being funded. The Onsite Review Panel has tried to state clearly the change or changes that are needed, but does not believe that funding should be provided without further external review to determine whether the problems have been resolved.

The Onsite Review Panel has traditionally divided Category 2 into two subdivisions:

Category 2A: Recommended to be revised and submitted in September for funding out of this year's cycle; and

Category 2B: Recommended to be revised and submitted during the next proposal cycle for a full three-tier review.

CATEGORY 3, having serious or structural flaws. Resubmission is not encouraged without important re-conceptualization and clarification that would be equivalent to a new proposal.

The Review Panel believes that Category 3 proposals require substantial rethinking and would not be recommended funding even if revised. Instead, entirely re-conceptualized proposals could be advanced in a subsequent proposal cycle. Proposals in this category are *not* rank-ordered.

Recommendations on the Individual Proposals

CATEGORY 1 - RECOMMENDED FOR IMMEDIATE FUNDING - ($11 MILLION)

The Onsite Review Panel did not assign a ranking to proposals within this category.

Clemson University
CoEE in Sustainable Development
$4 million Requested and Recommended for Funding
Chairs: Clemson University (1)

- **DESCRIPTION**

The proposal seeks state support for one endowed chair ($4 million) to create a South Carolina Center of Economic Excellence in Sustainable Development. The objective of the proposed CoEE is to catalyze innovations in technologies, materials, and informatics that foster sustainable development. The resultant products and services will enhance South Carolina's ability to protect its natural resources and to enhance smart growth solutions in the built environment. The "Intelligent River" program illustrates the potential of advancing technologies to foster sustainable economic development that is responsive to quality of life concerns.

- **STRENGTHS**

Clemson University is committed to advancing sustainability as a major institutional priority including, for example, the impacts of the built environment on natural resources; on ecosystem services; and on biological, chemical and physical processes. Momentum is building to create interdisciplinary degree programs at Clemson in sustainable development, coupled to an impressive array of existing CoEEs, programs and centers that have overlapping interests in sustainable development. These include restoration ecology, renewable energy, natural resources, sustainable design, land use planning, real estate development, and watershed management. Existing partnerships in economic, environmental and social aspects of sustainability include a diverse mix of universities in the region, as well as governmental agencies and non-profit organizations. The new federal funding focus on developing green technologies also bodes well for enhancing support for research efforts such as the ones proposed in this application.

The proposed CoEE in Sustainable Development will build on the above strengths. Both the technical review and the Onsite Review Panel rated the proposal very favorably in this round of CoEE proposal submissions. The "Intelligent River" project, pioneered by Gene Eidson, exemplifies a powerful multidisciplinary approach at Clemson linking aspects of water resources, land use management, energy policy and climate change. Real-time management of regional water resources, through the application of an advanced sensor and cyberinfrastructure, would establish the state as an international leader. There is also a concomitant emphasis on establishing new degree programs that will enrich a South Carolina-based workforce devoted to principles of sustainability.

Matching fund prospects for the endowed chair are excellent. There is a major $2 million pledge already in hand from a private donor. Also, a $700,000 gift is in-process, and $1.3 million is anticipated in federal equipment grants to meet the full matching commitment. There also are many potential public and private partners to collaborate in the development or use of the emergent technologies. The anticipated result will be the movement of basic research to observational data to informed decision-making, with direct and substantial impact on the South Carolina environment and economy.

- **WEAKNESSES**

The proposal is a significant improvement over the proposal presented in 2009 and identifies various opportunity areas where Clemson is positioned to lead the integration of IT resources with natural resources management. However, there remain several minor concerns, summarized as follows.

It is not clear how the CoEE chair and associated Center can be optimally integrated within the complex infrastructure at Clemson. Having the Center in one College and the CoEE Chair in another college makes sense from an interdisciplinary perspective, but adds additional complexity to administrative coordination. It would be useful to consider a formal management structure incorporating Clemson's VP for Public Service and Economic Development and the VP for Research to help assure high level support for the CoEE.

A second concern is that the "Intelligent River" program has not yet demonstrated the ability to link data to decision-making. Such a linkage is the core objective of the CoEE, and will require more extensive collaborations with academic units involved in public policy and social sciences. A third area of weakness is that there is little specificity in the proposed outcome measures. A comprehensive list appears on page 19 of the proposal, but quantitative targets are lacking as is an assessment plan to track outcomes and impact. A final concern is that the proposed CoEE Chair hire is not on the "fast track," but is stated to be about three years away. This may reflect the practicalities of a high level search and diverse funding streams needing to be established for the hire, but every effort should be made to recruit the CoEE Chair as expeditiously as possible.

- **ECONOMIC DEVELOPMENT**

The CoEE will facilitate public-private partnerships and the development of industries in South Carolina to deliver new technologies, materials, designs and products linked to "green economy" jobs. There are clearly opportunities to create and support jobs in aspects of the government-university-industry partnerships related to projects such as "The Intelligent River."

The proposal provides a viable framework around commercialization of research and the transfer of technologies, products or services in sustainable development. The business model incorporates the development of intellectual property and associated informatics tools across the dimensions of sensors, packaging, uplink infrastructure, observation middleware, and software. There are burgeoning commercial opportunities to develop component technologies, subscription services, and server appliances. A wide array of

partnership opportunities exists, both with the federal agencies (e.g., DoT, DoD, DoE, NOAA, USDA, DoI, EPA) and private sector clients (e.g., Sealevel, Hydropoint Data Systems, Oayses Water, and AqWise), in the Intelligent River effort.

- **RECOMMENDATION**

The Onsite Review Panel was impressed by the diversity of research and outreach efforts at Clemson University linked to issues of sustainability. The CoEE proposal is an ambitious and integrative attempt to combine engineering technology and cyberinfrastructure to support decision-making. There is a high potential for positive economic impact, including technology transfer of advanced sensor networks and informatics tools to serve clients in both government and private sectors. The rapid deployment of the "Intelligent River" program provides a compelling example of the promise for the CoEE chair to address broader platforms of sustainable development. The proposal is highly recommended for full state funding of $4 million.

University of South Carolina
CoEE in Data Analysis, Simulation, Imaging, and Visualization
$2 million Requested and Recommended
Chairs: USC (1)

- **DESCRIPTION**

This proposal requests funding for an endowed professorship as the foundation for a CoEE in Data Analysis, Simulation, Imaging, and Visualization. The CoEE will undertake workforce development through support of emerging undergraduate and graduate programs aligned with data analytics, and thus will contribute to the knowledge-based economy in South Carolina.

- **STRENGTHS**

This proposal seeks funding to address an important area of research and potential economic development, namely the analysis, modeling, and processing of large volumes of data. This is a fundamental problem that cuts across almost every discipline today including such areas as mechanical and aerospace engineering, chemistry, biology, and medicine. The Center will design innovative algorithms to improve the flow and interpretation of data collected by electron microscopes, earth remote sensing satellites, and supercomputer hydrodynamic simulations, etc.. The new algorithmic designs will impact fundamental and applied research at universities, industry, and government laboratories.

USC has a prominent history in this area of research. The Interdisciplinary Mathematics Institute (IMI) is internationally known and well respected. It focuses on basic research. The IMI will be leveraged to launch the new CoEE which will direct the proposed research toward applied problems. The highly interdisciplinary history of IMI can potentially guide the proposed CoEE into a number of applied fields simultaneously, thus increasing its probability of economic return via licensing of new algorithms or even spin-off companies applied to particular fields (e.g., DNA sequencing analysis).

The research track record of the IMI is very strong and suggests that the creation of the CoEE will result in prominent research with broad-ranging applications to science and technology issues. With the strong foundation of the IMI, the CoEE will likely attract prominent scholars and good students to a proposed master's program in Data Analytics.

USC has already secured a pledge of $2 million from a private foundation that will be used to match the requested funding.

- **WEAKNESSES**

The business model for this proposed Center is vague. It is unclear how the economic goals of the Center will be realized. The Onsite Review Panel requested current intellectual property metrics (e.g., revenue from licensed technology, patents issued) from USC specifically related to the output from IMI and related departments in the areas of data analysis, simulation, imaging, and visualization.

No market analysis was conducted on the proposed professional master's program in this topic. What is the evidence that local South Carolina industry needs such a degree? Is there a sufficient student population to justify the creation of a new graduate degree? It is not clear how this CoEE will impact the local workforce and companies in these fields of data analysis, simulation, imaging, and visualization. Given the difficult economic times, it is important to research both the need and likely success of such a new degree program before it is instituted.

How will the relationship between the CoEE and IMI evolve after the new Center is created? How will the proposers manage the creative tensions and preserve the boundaries between basic research at IMI and applied research at the CoEE?

A significant concern is the need for the CoEE to develop as an umbrella organization to connect various CoEEs that have a common interest in specialized tools for data analysis and visualization. How will those ties be promoted and integrated, both organizationally and financially? How will the CoEE be a catalyst for inter-disciplinary collaboration?

- **ECONOMIC DEVELOPMENT**

The Center will pursue technology transfer, although the economic impact is only described in very general terms. The "business model" undoubtedly will need to be tailored to a specific application or industry cluster. However, it is not apparent how the explicit needs of industry partners will be incorporated into the CoEE priorities, and the associated activities or performance metrics.

Promising commercial applications initially include image analysis as relevant to nanotechnology and biotechnology fields, as well as text analytics. It is projected that the proposed CoEE will ultimately create a local workforce of hundreds of trained professionals. Additional investments beyond the CoEE may be needed to retain these skilled workers in South Carolina and to encourage targeted growth in its knowledge-based economy and associated industry clusters.

- **RECOMMENDATION**

The proposed CoEE builds on existing strengths at USC and is relevant to a wide range of scientific and research endeavors. It is well positioned to engage various existing CoEEs and other units regarding common needs in data analytics and to encourage broader partnerships beyond USC. The external review committee recommends that USC elaborate on the issues raised in the previous sections related to "Weaknesses" and "Economic Development" prior to confirming our recommendation for full funding.

Medical University of South Carolina
Center for Inflammation and Fibrosis Research
$5 million Requested and Recommended
Chairs: MUSC (2)

- **DESCRIPTION**

MUSC seeks support for two endowed chairs in the creation of a Center of Economic Excellence for Inflammation and Fibrosis Research. The CoEE Chairs in Inflammation Research and in Fibrosis Research will complement and extend existing expertise in the pathobiology of disease with a focus on the development of novel therapeutic strategies for inflammatory and fibrosing conditions, major causes of chronic illness in South Carolina and around the country. The Center will focus its research on prevention, prediction and palliation of inflammatory and fibrotic diseases, building on a long history of excellence in this field. The Center will develop a statewide biomarker network to monitor disease activity and predict outcomes, will continue work on the identification and development of novel therapeutic targets, continue basic and clinical research, and develop new programs for training and education. The proposal requests $5 million from the CoEE Program and describes matching philanthropic funds of $2.3 million, with more gifts in progress. Economic development is anticipated through increased sponsored research activity, reduced health care costs, increased productivity from those with chronic illnesses, and revenue from commercialization. There is considerable potential for intellectual property development and commercialization of novel therapeutics.

- **STRENGTHS**

The proposed Center leverages a strong foundation by building on a powerful national reputation and long history of excellence in the field. Dr. Silver is a world-renowned leader in the treatment and study of scleroderma. While scleroderma is a relatively rare fibrotic disorder, Dr. Silver makes a compelling case for its utility as a model for related fibrotic diseases. Therefore, the research results and product development are likely to be broadly applicable. Similarly, Dr. Gilkerson is renowned for his work in a relatively infrequent inflammatory disease, systemic lupus erythematosis. He makes a similarly effective argument that research and development of novel therapeutics for this disease will be broadly applicable to other inflammatory disorders. MUSC is currently a major referral center for the treatment of inflammatory and fibrotic diseases, especially for scleroderma and lupus. The potential to increase clinical activity is great by expanding the expertise more broadly to related diseases. A governance structure for the Center is

well thought out and carefully articulated to engage existing CoEE's as collaborators. The existing research group has multiple products at various stages of development with promising preliminary results for commercialization.

- **WEAKNESSES**

Reviewers expressed some concern as to whether the continued focus on relatively rare conditions of scleroderma and lupus is justified for these new investment dollars. While this issue clearly can be seen from two sides, the project leaders make a compelling case for the utility of these relatively rare conditions as disease models. The research results and novel therapeutics developed using the disease models would be broadly applicable to a much larger population, and thus larger market, of individuals with related inflammatory and fibrotic diseases. The potential for development of a statewide biomarker network may be limited by the number of available cases. The proposal provides relatively modest information about the potential value added by the Center to education and training programs at MUSC. The review panel is confident in the likely success of this group in drug development and technology transfer, but offers caution about the critical importance of having adequate input in chemistry and pharmacology of new products.

- **ECONOMIC IMPACT**

Economic development is anticipated through increased sponsored research activity, reduced health care costs, increased productivity from those with chronic illnesses, and revenue from commercialization. The most immediate economic impact is likely to be seen in increased competitiveness for federal and other external grant funding. The anticipated immediate return of $1 million per year in new grant revenue is aggressive but realistic. The generation of commercializable products and the creation of patents, licenses and start-up companies is predicted to generate $1 million to 2 million per year, a reasonable possibility based on the status of new products already under development. A compelling case is made for significant indirect economic benefit through increased productivity and reduced morbidity among those suffering from chronic inflammatory and fibrotic illnesses. The overall impact prediction of $6 million to $10 million per year is aggressive but feasible depending largely on the successful translation of newly developed therapeutics. It should be noted that the timeline is long and the risks are high for bringing new therapeutics to market.

- **RECOMMENDATION**

This is an outstanding proposal that addresses an important and chronic health problem in South Carolina and elsewhere for which little effective treatment is available. The plan for implementation is sound, clearly articulated and well justified. The program builds solidly on a long history of accomplishment at MUSC in this focus area. Confidence is high for success in drug development and technology transfer. The recruitment of two Endowed Chairs as proposed will help to propel this group well ahead of national competitors. The potential is high for positive impact on health and economy in South Carolina.

The panel recommends full funding for two endowed chairs as requested.

CATEGORY 2 - MERITORIOUS, BUT WITH NEED FOR IMPROVEMENT AND FURTHER REVIEW BEFORE RECOMMENDATION FOR FUNDING

None

CATEGORY 3, having serious or structural flaws. Resubmission is not encouraged without important re-conceptualization and clarification that would be equivalent to a new proposal.

University of South Carolina
Center for Advancement of Health Care
$5 million Requested - Not Recommended for Funding
Chair: USC (1)

- **DESCRIPTION**

USC seeks support for an Endowed Chair for Health Care Innovation to direct a newly formed Institute for the Advancement of Health Care (IAHC). The role of the IAHC is to serve as the cornerstone for an existing alliance between USC and the Greenville Hospital System University Medical Center (GHS). The Chair will work with key constituents to develop, promote, and implement a research agenda emphasizing clinical translational research. The research agenda will focus on innovative, comprehensive models that have been tested in the IAHC, then implemented in community settings, with the goal of developing efficient, patient-centered practices and health care systems that improve clinical effectiveness and patient safety, reduce heath disparities, and promote wellness. USC and GHS have pledged $5M towards the creation of the IAHC and they are seeking a $5 million match from the State of South Carolina.

- **STRENGTHS**

The IAHC would add additional structure to assure a more productive relationship between two strong partners, USC and GHS. A collaborative partnership already exists between these two organizations; they were awarded the Childhood Neurotherapeutics CoEE in 2006. The anticipated outcome for the IAHC is improved health and well being of South Carolina citizens through the creation of new, novel programs aimed at promoting health and enhancing health care treatment. A comprehensive model of health and health care delivery is underway, Total Health, with an initial focus on diabetes. Total Health is focused on interventions all along the spectrum of health care from prevention, to subsequent complications, comorbidities, disabilities, recurrence, and mortality. These efforts are expected to yield around 17 new jobs with employment income over $1.3 million initially, and projections assuming a statewide implementation are much larger. Ultimately, a successful outcome from these efforts would be reductions in health care cost and/or better disease outcome.

- **WEAKNESSES**

The Onsite Review Panel expressed some confusion regarding the focus of a newly formed IAHC. While the onsite presentation provided an excellent summary regarding the benefits of a stronger partnership committed to comprehensive management of chronic disease, it would have been helpful to learn more regarding the implementation and tasks associated with the center. The proposed project is very large in scope and seems to lack the focus necessary to meet the goals for a CoEE award. Members of the committee would have preferred better defined criteria regarding the credentials for prospective endowed chair candidates.

- **ECONOMIC IMPACT**

It is anticipated that IAHC will facilitate more than $1.3 million (17 jobs) in labor income initially that will eventually stimulate more than $57 million (1,080 jobs) in statewide labor income. The applicants also note the opportunity to generate health data and related technologies from the efforts of this program as well as out-licensing of remote management technology. However, it was not clear how IAHC would direct research in a manner that would directly stimulate invention and job growth outside the partnership. The reviewers felt that the economic impact, outside of job creation within the partnership, was low. On the other hand, the potential for cost savings seems realistic, but the timeline to achieve these savings was not clear.

- **RECOMMENDATION**

While the general focus of the proposed CoEE for Advancement of Health Care on today's challenges and opportunities in health care is clearly important, the role of this new Center in achieving better health care goals for South Carolina was not as clear. In addition, economic impact outside of the partnership was deemed low given the expectations for South Carolina's CoEE Program.

The panel does not recommend funding for the proposed CoEE for Advancement of Health Care.

Medical University of South Carolina
Longevity Institute
$5,000,000 Requested - Not Recommended for Funding
Endowed Chairs: MUSC (1)

- **DESCRIPTION**

MUSC proposes to establish a CoEE to be named the Carolina Longevity Institute. They will appoint a new endowed chair, either an M.D., Ph.D. or M.D.-Ph.D., based in an appropriate department in the College of Medicine at MUSC ($2 million). The proposed CoEE Chair is intended as the fourth chair of the SeniorSMART CoEE. The initiative has received a pledge for an additional $5 million for institute endowment from a private donor. The remainder of state funds will go towards set-up funds and first year salary for the Chair as well as Center operations ($3 million). The Chair will head the Longevity Institute and will focus on three aspects of longevity: understanding the basic biology underlying longevity, development of educational programs to promote longevity, and the transfer of new knowledge to clinical applications.

- **STRENGTHS**

Several other CoEEs and institutes that may provide fruitful collaborations are present at MUSC, USC, and Clemson. These include the Center on Aging, the Neurosciences Institute and the SeniorSMART program, the CoEEs in Neuroscience and in Drug Discovery, and the Institute for Nutraceutical Research, the National Nutritional Center, and USDA Vegetable Laboratory, among others. There is considerable faculty strength in these units as well as a number of other research resources that would be available to the proposed Chair. A scientific board of advisors is planned and a reasonable assessment plan described—although the particulars to be measured were missing. Also, there are plans in place to try to secure other funding for the program from the EPA.

- **WEAKNESSES**

Numerous model systems and mechanistic approaches exist for the study of how lifespan is regulated, yet the committee members would have liked a better focused plan on future research directions. The goals were diffuse without clear priorities, ranging from education of school-age children to the development of commercially viable nutraceuticals. The program as written lacked innovation. Many of the initiatives described are already onoing, and it is not clear how the proposed program would strengthen ongoing efforts. The SeniorSMART program with its current three CoEE Chairs is already doing well, and the arguments for a fourth chair were not convincing. How the Longevity program would specifically interface with other units was not clear nor was the plan to interface with ongoing research projects in other units. There was a dearth of information on educational aspects of the Center especially with regards to graduate student training. There were issues with economic impact as described below. Lastly, the Clemson National Nutraceutical Center and other Clemson research institutes as well as the USDA Vegetable Laboratory are thought to be key collaborators, yet no letters of support were included in the application.

- **ECONOMIC IMPACT**

The first area of economic growth if the proposed chair is funded is anticipated to be in the areas of education, prevention and lifestyle changes. How this would lead to jobs in the health industry was not clear, although a healthier populace would clearly bring long term economic benefits. A few jobs could be created among educators to spread the new knowledge among healthcare workers and the populace in general. The presenters stated that jobs would be created through pharmaceutical industry and agribusiness jobs, but there was no convincing argument for having such jobs created solely in the State. The economic impact of the proposed program was neither well articulated nor convincing.

- **RECOMMENDATION**

The lack of specificity for the proposed CoEE both in the qualities to be sought in the endowed chair candidates and in the programmatic aspects of how the initiative would interface with existing efforts in SeniorSMART left the Onsite Review Panel concerned about the leadership of the initiative and its chances for success. The economic benefits of a healthier population are clear but not the prospects for shorter term job creation. Overall, the Onsite Review Panel felt that the proposal lacked focus and compelling rationale. Neither the value added by its creation nor its near-term economic impact was apparent. The Onsite Review Panel does not recommend funding for this proposal.

SUMMARY OF 2009-2010 COEE ONSITE REVIEW PANEL AWARD RECOMMENDATIONS

Category One Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
Sustainable Development (Clemson)	1			$4,000,000
Data Analysis (USC)			1	$2,000,000
Inflammation and Fibrosis Research (MUSC)		2		$5,000,000
TOTAL	**1**	**2**	**1**	**$11,000,000**

Category Two-A Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
NONE				

Category Two-B Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
NONE				

Category Three Recommendations	Chairs to Clemson	Chairs to MUSC	Chairs to USC	Total $
Longevity Institute (MUSC)				$0
Health Care Advancement (USC)				$0

Part Five: Conclusion

As noted in previous reports, the Onsite Review Panel believes that the CoEE Program is exceptionally strong. There is no question that the investments made in the previously recommended programs are beginning to yield extraordinary benefit for South Carolina.

Despite the great strengths of this program, South Carolina cannot assume that current achievements will ensure competitiveness. The competition to be a leader in the knowledge economy is getting tougher, as more and more states and nations appreciate the need to rethink their educational and research structures. The race will not end soon, and it would be a disaster for South Carolina to pause, much less drop the CoEE

Program, just as others are beginning to consider similar strategies. South Carolina needs to continue its bold but also balanced and prudent investments in the knowledge economy.

The Onsite Review Panel strongly believes that this program should be continued and strong consideration should be given to creating new funding to aid the universities in offering competitive start-up packages to the CoEE Endowed Professors which are recruited. The three universities have invested in their technology transfer offices, but it is not clear that the current level of support for these activities will be sufficient, as more and more intellectual property is developed by the CoEE Chairs and their research teams. The universities should consider having an outside analysis of their capabilities in the area of technology transfer in order to plan for adequate resources to support the expanded efforts that will be generated as the Centers mature. In addition, there is considerable need for pre-seed funding for start-up companies being formed out of the CoEE Program.

The CoEE Program is outstanding initiative and demonstrates the enlightened thinking of state and institutional leaders. The CoEE Program is attracting national attention and will produce new ideas resulting in the creation of new, high-quality jobs for the citizens of South Carolina.

APPENDIX A

South Carolina Centers of Economic Excellence Funded Proposals

In 2002, the South Carolina General Assembly passed the Research Centers of Economic Excellence Act in order to promote growth of the knowledge-based economy in South Carolina. Oversight of the Centers of Economic Excellence (CoEE) Program is provided by the S.C. Centers of Economic Excellence Review Board. The South Carolina Commission on Higher Education approves the budget for the CoEE Review Board's operations and also provides staff support for the program's day-to-day operations. South Carolina Education Lottery funds in the amount of $180 million have been appropriated for the program since the 2002-2003 Fiscal Year. Over the last seven years, 46 research proposals totaling $186.6 million have been approved for funding. South Carolina's three research institutions are required to raise dollar-for-dollar, non-state matching funds in order to access state funding.

The most current information on the CoEE Program is available at www.sccoee.org . A list of funded proposals follows:

Funding Year 2002-2003			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Automotive Systems Integration	1	$5 million
Clemson	Automotive Manufacturing	1	$5 million
USC	Nanostructures	1	$4 million
USC/MUSC	Brain Imaging	3*	$5 million
MUSC	Proteomics	1	$4 million
MUSC	Neuroscience	3	$3 million
MUSC/USC/CoC	Marine Genomics	3**	$4 million
Total Awarded in 2002-2003		**13**	**$30 million**
Funding Year 2003-2004			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Automotive Design & Development	1	$5 million
Clemson	Electronic Systems Integration	1	$3 million
Clemson	Photonic Materials	1	$5 million
USC	Polymer Nanocomposites	1	$3.5 million
USC	Hydrogen & Fuel Cell Economy I ***	2	$2.5 million
MUSC/Clemson/USC	Regenerative Medicine	3	$5 million
MUSC/USC	Translational Cancer Therapeutics	2	$5 million
Total Awarded in 2003-2004		**11**	**$29 million**

* Revised to three chairs by act of the CoEE Review Board on January 12, 2009.
** Revised to three chairs by act of the CoEE Review Board on February 23, 2010.
*** The Hydrogen & Fuel Cell Economy CoEE was approved during 2003-2004. Funding for one half of this CoEE was provided in 2003-04, the other half in 2004-2005.

S.C. Centers of Economic Excellence Funded Proposals (continued)

Funding Year 2004-2005			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Restoration [WITHDRAWN]	—	[$3 million]
Clemson	Electron Imaging [WITHDRAWN]	—	[$5 million]
USC	Renewable Fuel Cells	1	$3 million
USC	Hydrogen & Fuel Cell Economy II*	[See 03-04.]	$2.5 million
USC/Coastal Carolina	Tourism & Economic Development	1	$2 million
MUSC	Gastrointestinal Cancer Diagnostics	2**	$5 million
MUSC/USC	Cancer Drug Discovery	4	$5 million
MUSC/USC	Vision Science	3	$4.5 million
Total Awarded in 2004-2005		**11**	**$22 million**

Funding Year 2005-2006			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Supply Chain Optimization & Logistics	1	$2 million
Clemson	Urban Ecology and Restoration	1	$2 million
Clemson	Advanced Fiber-Based Materials	1	$4 million
Clemson	Molecular Nutrition [WITHDRAWN]	—	[$2 million]
USC	Solid Oxide Fuel Cells	1	$3 million
USC/MUSC	Childhood Neurotherapeutics	3	$5 million
MUSC	Molecular Proteomics in Cardiovascular Disease & Prevention	2	$5 million
MUSC/USC	Clinical Effectiveness & Patient Safety†	3	$5 million
Total Awarded in 2005-2006		**12**	**$26 million**

Funding Year 2006-2007			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson/MUSC	Health Facilities Design & Testing	2	$5 million
USC	Rehabilitation and Reconstruction Science	1	$5 million
USC	Strategic Approaches to Electricity Production from Coal	1	$5 million
USC/MUSC/Clemson	Healthcare Quality	2	$5 million
USC/Clemson	Senior SMART™ Center ±	3	$5 million
MUSC	Tobacco-Related Malignancy	2	$5 million
MUSC/USC	Stroke	3	$5 million
Total Awarded in 2006-2007		**14**	**$35 million**

* The Hydrogen & Fuel Cell Economy CoEE was approved during 2003-2004. Funding for one half of this CoEE was provided in 2003-04, the other half in 2004-2005.
** Increased from one to two by act of the CoEE Review Board on September 8, 2008.
† On September 9, 2008, the CoEE Review Board approved a revision to this proposal which relinquished Clemson University as a collaborative partner and transferred the CoEE chair at Clemson to MUSC.
± The SeniorSMART CoEE was approved in 2007-2008. Funding was provided from 2006-2007 dollars.

S.C. Centers of Economic Excellence Funded Proposals (continued)

Funding Year 2007-2008			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Optoelectronics	1	$2 million
Clemson	Cyber-Institute	1	$2 million
USC	Nanoenvironmental Research & Risk Assessment	1	$3 million
USC	Nuclear Science and Energy	1	$3 million
MUSC	Renal Disease Biomarker	2	$5 million
MUSC/Clemson	Cancer Stem Cell Biology	2	$5 million
MUSC/USC/Clemson	Advanced Tissue Biofabrication	3	$5 million
MUSC/USC/SCSU	Cancer Disparities*	3	$3.6 million
MUSC/USC	Medication Safety & Efficacy*	1	$2 million
Total Awarded in 2007-2008		**15**	**$30.6 million**

Funding Year 2008-2009			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Tissue Systems Characterization	1	$3 million
USC	Nuclear Science Strategies	1	$3 million
USC/MUSC	Healthful Lifestyles**	2	$3 million
MUSC	Lipidomics, Pathobiology and Therapy	2	$5 million
Total Awarded in 2008-2009		**6**	**$14 million**

* The Cancer Disparities CoEE and the Medication Safety & Efficacy CoEE were approved in 2008-2009. Funding was provided from 2007-2008 dollars.
** The Healthful Lifestyles CoEE was approved in 2009-2010 with funding from 2008-2009 dollars.

Program Totals	
TOTAL LOTTERY APPROPRIATIONS (2002-2009)	**$180 million**
ACCRUED PROGRAM INTEREST USED FOR ADDITIONAL AWARDS *	**$6.6 million**
TOTAL FUNDS AWARDED (2003-2009)	**$186.6 million**

* As permitted by S.C. 2-75-30(A).

Research Institution Totals			
Institution	**Number of Centers**	**Number of Endowed Chairs**	**State Funds Drawn**
Clemson University	12	15	$35,389,299
USC	16	28	$33,910,962
MUSC	18	39	$52,204,841
TOTALS	46	82	$121,505,102

[Last updated June 1, 2010.]

APPENDIX B

Paula Harper Bethea
Chair

May 18, 2009

President James F. Barker
Clemson University
201 Sikes Hall
Clemson, SC 29634

President Raymond S. Greenberg
Medical University of South Carolina
135 Cannon St., Suite 101
Charleston, SC 29425

President Harris Pastides
University of South Carolina
Osborne 206
Columbia, SC 29208

Dear Presidents Greenberg, Barker and Pastides:

At the recent CoEE Onsite Review Panel, each institutional president independently discussed during private sessions with the Panel the general programmatic philosophy of whether the Research Centers of Economic Excellence (RCEE) Act intended for proposals to be "chair-based" or "center-based." There appeared to be a general opinion among the institutions that the CoEE Review Board had mandated a "center-based" interpretation of the RCEE Act.

President Barker made a statement to the effect that the original structure of the Clemson University International Center for Automotive Research (CU-ICAR) was no longer viable; that is, the CoEE Review Board no longer favored the creation of a general umbrella center, such as CU-ICAR, under which a number of chairs in the amount of $2 million to $5 million could be situated. Another example of such an "umbrella center" might be USC's Future Fuels Initiative, under which are situated USC CoEEs such as Solid Oxide Fuel Cells, Renewable Fuel Cells for the Fuel Cell Economy, Hydrogen Fuel Cells, etc.

I write to you today to clarify that the Review Board has not imposed a preferred model, contrary to what seemed to emerge in discussions with the Panel. In fact, in 2006, the CoEE Review Board created a flexible policy with respect to "chair-based" or "center-based" proposals. When it became clear that institutions were following different models, the CoEE Review Board revised the Program *Guidelines* in the following manner:

> Individual proposals may be for (a) a single endowed professorship; (b) single or multiple professorships clustered in a new research center; or (c) single or multiple professorships clustered in an already existing research center. [Section XIV-e]

This version was made to allow for flexibility and to avoid imposing one model on everyone.

Thus, there exists a number of ways by which a senior research institution might align its CoEE within current institutional structure. The CU-ICAR and USC Future Fuels model is acceptable. Also acceptable is the Clemson practice of incorporating CoEEs into currently existing research centers, such as the Photonic Materials CoEE with the broader Center for Optical Materials Science and Engineering. And, of course, it remains acceptable for an institution to create a single CoEE chair which is not interrelated to any existing institutional research center (Tourism and Economic Development CoEE at USC).

I think it important not to confuse how endowed chairs may be administratively structured with the branding of the program by our marketing firm as the CoEE program. Perhaps this is the source of confusion as to what is allowable.

The On-Site Review Panel did express some concern about the proliferation of many small Centers as opposed to consolidation of a critical mass of chairs under broader Centers. While the pros and cons of the different approaches were briefly discussed, the flexibility inherent in the revised *Guidelines* noted above remains in effect.

Please let me know if you have any additional questions on this matter.

Sincerely yours,

Gail M. Morrison, Ph.D.

CHE Deputy Director, Director,
Academic Affairs & Licensing

cc: Ms. Paula Harper Bethea, Dr. Chris Przirembel, Dr. John Raymond, Dr. Rose Booze.